University of Ghana http://ugspace.ug.edu.gh

SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA

STRENGTHENING HEALTH SYSTEMS FOR QUALITY HEALTH CARE: A STUDY OF MISDIAGNOSIS AMONG HOSPITALISED PATIENTS IN GENERAL HOSPITALS IN UGANDA

BY

SIMON PETER KATONGOLE

STUDENT ID NO (10642012)

THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF PHD IN PUBLIC HEALTH DEGREE

DECEMBER 2023

University of Ghana http://ugspace.ug.edu.gh

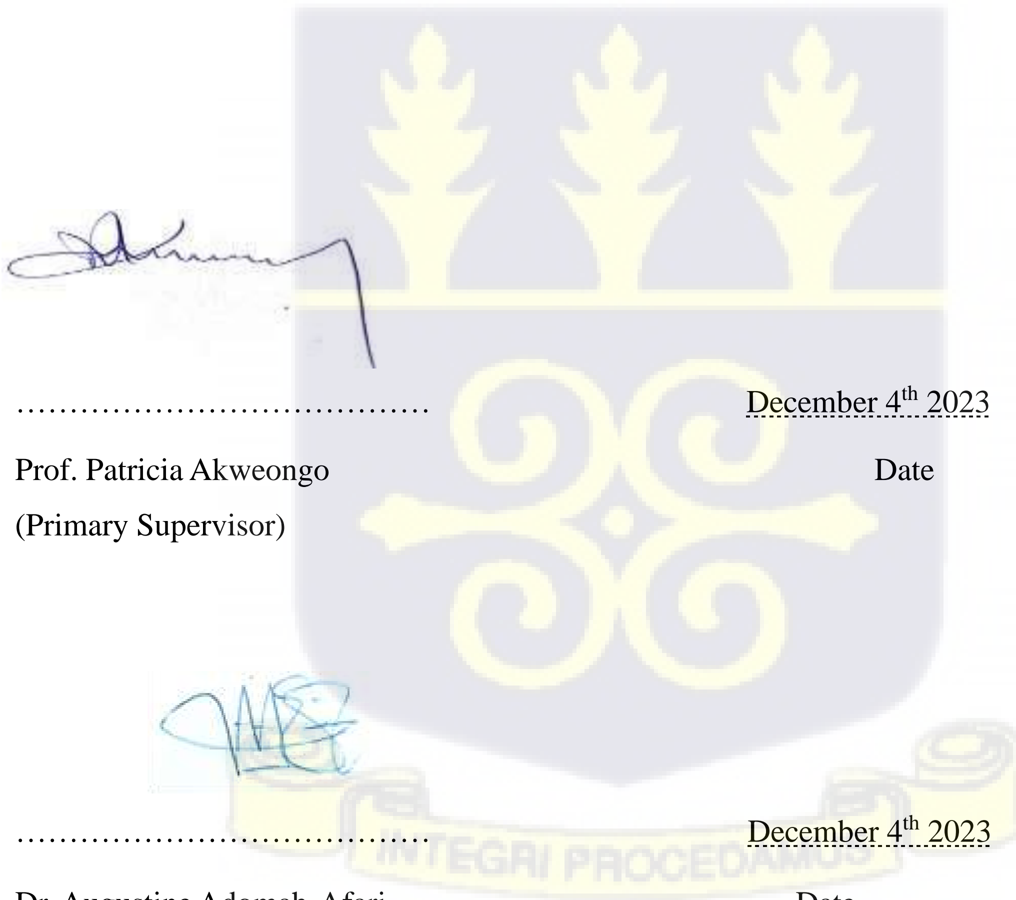
DECLARATION

I, Simon Peter Katongole hereby declare that this thesis is a product of my own PhD research work conducted under the supervision, except for the references cited in this thesis which have been duly acknowledged. I further declare that no part or whole of this thesis has ever been submitted for the award of any degree in any University elsewhere.

.... December 4th 2023

Simon Peter Katongole Date

(Student)



.... December 4th 2023

Prof. Patricia Akweongo Date

(Primary Supervisor)

.... December 4th 2023

Dr. Augustine Adomah-Afari Date

(Secondary Supervisor)

University of Ghana http://ugspace.ug.edu.gh

DEDICATION

To my Education Visionary Parents (E-VIPs), my late father, Emmanuel Kakooza who died just as I was about to defend this thesis, (May you rest in Glory), and my mother, Mrs. Demetria Angela Kakooza.

University of Ghana http://ugspace.ug.edu.gh

ACKNOWLEDGEMENT

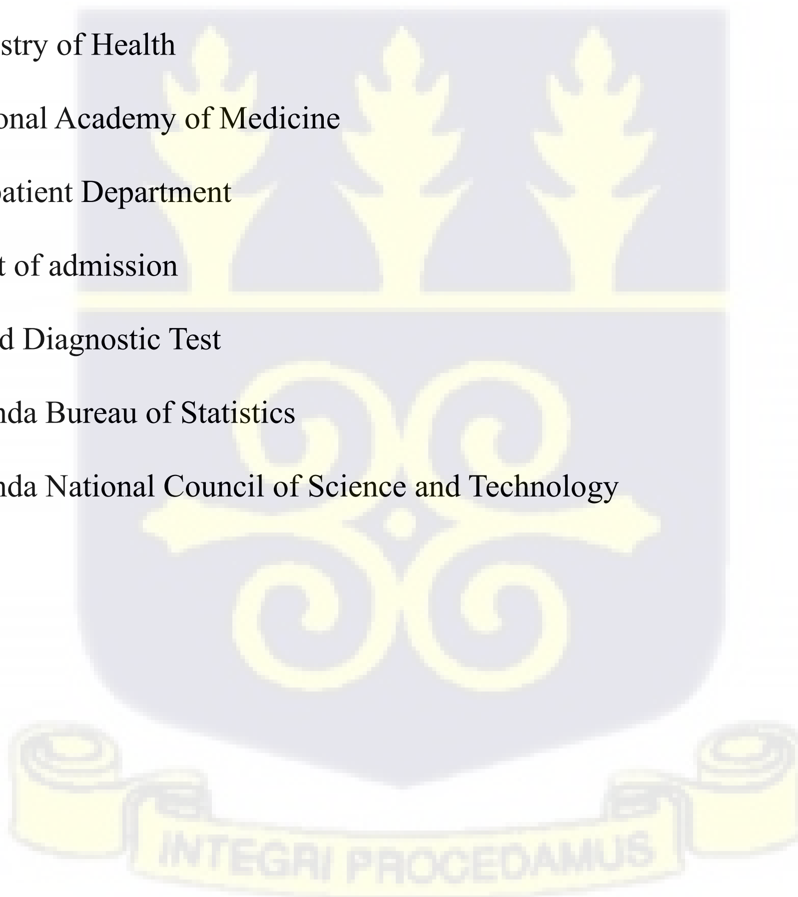
Glory be to the Highest God who has brought me this far in my academic career. In part thanks to the Partnership for Health Training in Africa (P4PHT) scholarship and the European Union who partly paid for my studies. I would especially like to express my gratitude to my supervisors, Associate Prof. Patricia Akweongo and Dr. Augustine Adomah-Afari, and all staff at the Department of Health Policy, Planning and Management, School of Public Health, University of Ghana for their unwavering support, advice, and encouragement throughout this journey. I want to thank classmate who has become a brother, Peter Yaro Badmak for all the moral, financial, and spiritual support you have given me during my time in Ghana. Cohort 5 PhD classmates, I am so appreciative of your support and advice as we traveled together.

I owe my wife Sarah Nagawa Nsiime a debt of gratitude for supporting me emotionally during this difficult time. I also thank her for putting up with my absence while I was away, and for taking care of our children. Thank you to our sons Emmanuel Xavier Kakooza and Maximilian Kolbe Ssenyondo for putting up with my absence. My parents who laid the groundwork for my education, I will always be grateful for your support and prayers. All of my siblings, I appreciate your financial and moral support throughout my life.

My former professors and supervisors at Uganda Martyrs University, Drs. Miisa Nanyiingi, Everd Maniple Bikaitwoha, and Mugisha John Francis deserve credit for my success. Special thanks to my mentor, Robert Anguyo, who always provided professional advice. Robert Tasaga, I appreciate your financial contribution. I want to express my gratitude to all the administrators and medical personnel at the hospitals where I conducted this study for letting me use your facilities and resources as well as accepting me to conduct this study.

University of Ghana http://ugspace.ug.edu.gh

LIST OF ABBREVIATIONS



AHSPR	Annual Health Sector Performance Report
ED	Emergency Department
FNER	False Negative Error Rate
FPER	False Positive Error Rate
HC	Health Centre
ICD-11	International Classification of Diseases Version 11
IOM	Institute of Medicine
IRB	Institutional Review Board
MoH	Ministry of Health
NAM	National Academy of Medicine
OPD	Outpatient Department
POA	Point of admission
RDT	Rapid Diagnostic Test
UBOS	Uganda Bureau of Statistics
UNCST	Uganda National Council of Science and Technology

University of Ghana http://ugspace.ug.edu.gh

DEFINITION OF TERMS

Allied health professional: A health worker usually with at a diploma level involved in the provision of curative and preventive services including identification, treatment, prevention, and rehabilitation of diseases and disorders among others.

Clinical officer: A health worker with a three-year diploma training in clinical medicine and community health who by law is mandated to deliver high quality and efficient medical care to patients and clients including diagnosing patient ailments and prescription of treatment as well as ensuring the promotion of public health in his or her area of operation.

Diagnostician: A health care professional (physician, physician assistant, medical assistant, clinical officer, comprehensive nurse and others) who has undergone medical training and is licensed to provide diagnosis to patients.

Diagnostic error: the failure to accurately and timely establish what a patient's problem is including the failure to inform the patient that the accurate diagnosis regarding his or her ailment has not been arrived at or is delayed.

Explicit data retrieval/review: Extraction of data from medical records with the guidance of a comprehensive predetermined or well-defined criterion.

General hospital: A healthcare facility with a bed capacity between 100 and 200 that provides outpatient and inpatient care. In addition to serving as district referral centers to their district and, sometimes, neighboring districts, these healthcare centers provide a wide range of preventive, primary, and medical services, including diagnosis, treatment, and surgery, as well as serving as the primary healthcare centres for their surrounding areas of within five-kilometre radius.

Implicit data review: Extraction of data from medical records by an expert reviewer based on his or her own understanding of the ideal quality of care of a specific care process.

University of Ghana http://ugspace.ug.edu.gh

Misdiagnosis: A situation where the diagnosis assigned to the patient's illness or condition by the diagnostician is erroneous or incorrect.

University of Ghana http://ugspace.ug.edu.gh

Table of Contents

DECLARATION ... i
DEDICATION ... ii
ACKNOWLEDGEMENT ... iii
LIST OF ABBREVIATIONS ... iv
DEFINITION OF TERMS ... v
LIST OF TABLES ... xi
LIST OF FIGURES ... xii
ABSTRACT ... xiii
CHAPTER ONE ... 1
INTRODUCTION ... 1
1.1 Background to the study ... 1
1.2 Problem statement ... 4
1.3 Justification of the study ... 5
1.4 Reflexivity on framing the study ... 7
1.5 Objectives of the study ... 7
1.5.1 General objective ... 7
1.5.2 Specific objectives ... 7
1.5.3 Research questions ... 8
1.6 Outline of the thesis ... 8
CHAPTER TWO ... 10
LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK ... 10
2.1 Introduction ... 10
2.2 Quality of Care / Patient Safety ... 10
2.3 Patient misdiagnosis ... 11
2.4 Uganda's health system ... 12
2.5 Establishing and measuring misdiagnosis ... 16
2.6 Prevalence of misdiagnosis ... 23
2.7 Classification of misdiagnosis ... 24
2.7.1 Major diagnostic groupings and diseases accounting for common misdiagnosis ... 26
2.8 Factors associated with misdiagnosis ... 26
2.8.1 Patients' related factors associated with misdiagnosis ... 27
2.8.2 Disease related factors influencing misdiagnosis ... 35
2.8.3 Health system factors contributing to misdiagnosis ... 39
2.9 Theoretical frameworks ... 62
2.9.1 The safer Dx framework and misdiagnosis ... 62
2.9.2 Patient Misdiagnosis through the Health Systems Building Blocks Framework ... 65
2.10 Theoretical triangulation: Conceptual framework for system factors pathway to patient misdiagnosis ... 70
2.11 Chapter summary ... 76
CHAPTER THREE ... 77
RESEARCH METHODOLOGY ... 77
3.1 Introduction ... 77

University of Ghana http://ugspace.ug.edu.gh

3.2 Philosophical assumption ... 77
3.2.1 The critical realism research paradigm ... 79
3.3 Research Methodology ... 81
3.3.1 Quantitative research methodology ... 81
3.3.2 Qualitative research methodology ... 82
3.3.3 Mixed Methods Research Approach ... 82
3.3.4 Research design ... 83
3.3.5 Study area ... 84
3.3.5 Sample size determination ... 90
3.3.7 Sampling technique ... 92
3.4 Study variables ... 94
3.4.1 Dependent variables ... 94
3.4.2 Independent variables ... 95
3.5 Data collection ... 100
3.5.1 Quantitative Data Collection (Records review) ... 100
3.5.2 Qualitative data collection (in-depth interviews) ... 105
3.6 Quality assurance ... 107
3. 7 Data management and analysis ... 110
3. 7. 1 Quantitative data analysis ... 110
3. 7. 2 Qualitative data analysis ... 117
3.8 Ethical considerations ... 118
3.9. Chapter Summary ... 121
CHAPTER FOUR ... 123
RESULTS ... 123
4.1 Introduction ... 123
4.2 Quantitative results ... 123
4.2.1 Characteristics of the Patients' Records reviewed ... 124
4.2.2 Prevalence of misdiagnosis ... 126
4.2.3 Misdiagnosed conditions ... 126
4.2.4 Classification of misdiagnosis ... 126
4.2.5 The topmost major diagnostic groupings and disease conditions misdiagnosed ... 127
4.2.5.1 Pareto Chart for topmost misdiagnosed major diagnostic groupings ... 128
4.2.5.3 Pareto Analysis of The Topmost Misdiagnosed Diseases Misdiagnosed Occurring More Than Once ... 130
4.2.6 Logistic regression analysis to determine factors associated with patient misdiagnosis ... 133
4.2.6.1 Bivariate logistic regression analysis: Association between patient, disease, environment and health system factors and misdiagnosis ... 133
4.2.6.2 Multivariable logistic regression analysis: Association between patient, disease, environment and health system factors and misdiagnosis ... 138
4.3 Qualitative Results ... 141
4.3.1 Background of the interviewees ... 141
4.3.1 Disease related factors and misdiagnosis ... 141
4.3.1.1 Common conditions top list of misdiagnosed diseases ... 142
4.3.1.2 Low index of suspicion of certain diseases ... 142

University of Ghana http://ugspace.ug.edu.gh

4.3.1.3 Diagnosticians' propensity to make diagnoses they are familiar with 143
4.3.1.4 Presence of underlying diseases and misdiagnosis 143
4.3.1.5 Patient related factors and misdiagnosis 145
4.3.1.6 Human resources for health and misdiagnosis 148
4.3.1.7 Service Delivery and Misdiagnosis 153
4.3.1.8 Laboratory and Radiological Investigations and Patient Misdiagnosis 157
4.3.1.9 Medical technology and equipment and misdiagnosis 159
4.3.1.10 Leadership, Governance and Organization of Care on Misdiagnosis 160
4.3.1.11 Information, communication and technology 163
4.4 Situating the Study Findings in the Conceptual Framework 164
4.5 Chapter summary 166
CHAPTER FIVE 167
DISCUSSION 167
5.1 Introduction 167
5.2 Outcome factors and Misdiagnosis 167
5.2.1 The proportion of patient misdiagnosis 167
5.2.2 Classification of patient misdiagnosis 169
5.2.3 The topmost ICD-11 major diagnostic groupings and diseases misdiagnosed 169
5.3 Structure factors and Misdiagnosis 174
5.3.1 Disease-related factors and patient misdiagnosis 174
5.3.2 Patient-related factors affecting misdiagnosis 176
5.3.3 Health system-related factors and patient misdiagnosis 182
5.3.3.1 Services delivery 183
5.3.3.2. Leadership and governance 185
5.3.3.3 Access to essential medical products, vaccines, and technologies 189
5.3.3.4 Influence of human resources for health on misdiagnosis 191
5.4 Chapter summary 196
CHAPTER SIX 197
SUMMARY, CONCLUSION AND RECOMMENDATIONS 197
6.1 Introduction 197
6.2 Summary of the study 197
6.3 Conclusion of the study 198
6.4 Contribution of the study 201
6.5 Recommendations of the study 202
6.6 Further Research 207
6.7 Limitations to the study 207
REFERENCES 210
APPENDICES 259
Appendix A. The ICD-11 coding of the initial and final diagnoses for the misdiagnosed patients (n=223) 259
Appendix B: Consent Form for In-Depth Interview 263
Appendix C: Data extraction form 265
Appendix D: Semi-structured (In-depth) Interview guide for health workers/diagnosticians ... 267

University of Ghana http://ugspace.ug.edu.gh

Appendix E: The major diagnostic ICD-11 grouping classification 269
Appendix F: HMIS form 051: Inpatient Treatment Sheet 270
Appendix G: HMIS form 052: Inpatient Discharge Form 271
Appendix H: HMIS Form 054: Inpatient Register 273
Appendix I. Map of Uganda showing study location 275
Appendix J. Institution Review Board approval 276
Appendix K: Uganda Nation Council of Science and Technology approval 277

University of Ghana http://ugspace.ug.edu.gh

LIST OF TABLES

Table 3.1: Analysis of the financial year 2019/2020 staffing in the hospitals 87

Table 3.2: Minimum proportion of patients' records to review 91

Table 3.3: Independent variables 96

Table 3.4: Examination of qualitative variables impacting patient misdiagnosis within the health system building blocks perspective 97

Table 3.5: Classification of misdiagnosis using ICD-11 113

Table 4.1: Characteristics of the patients' records reviewed (N=2431) 125

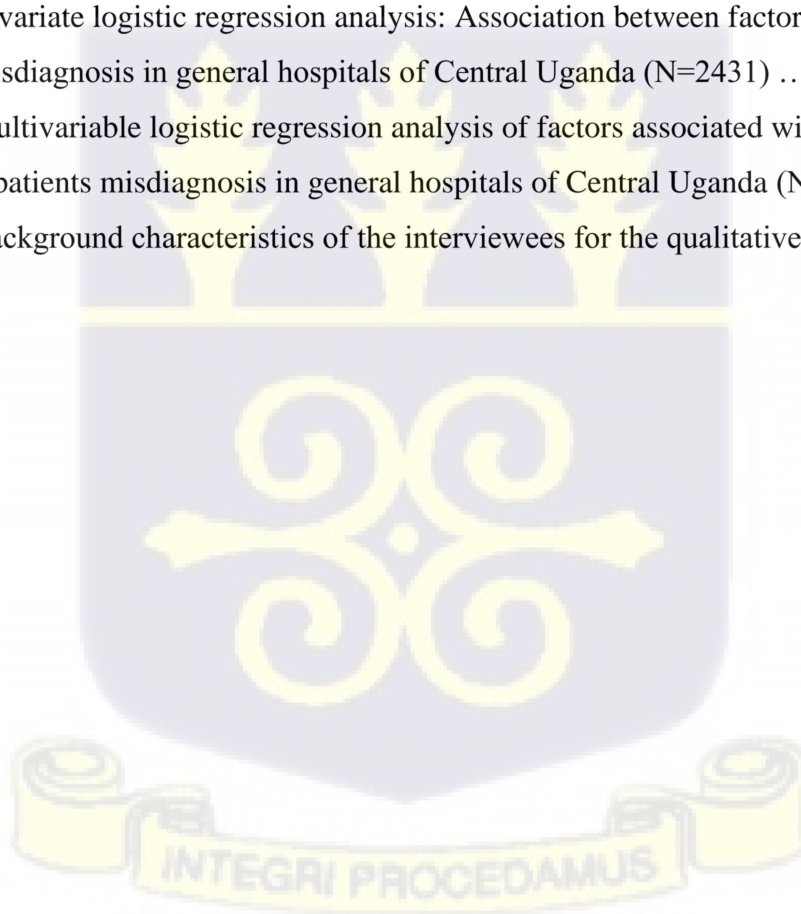
Table 4.2: Prevalence of misdiagnosis... 126

Table 4.3a Bivariate logistic regression analysis: Association between factors and misdiagnosis in general hospitals of Central Uganda (N=2431) 136

Table 4.3b Bivariate logistic regression analysis: Association between factors and misdiagnosis in general hospitals of Central Uganda (N=2431) 137

Table 4.4: Multivariable logistic regression analysis of factors associated with inpatients misdiagnosis in general hospitals of Central Uganda (N=2431) ... 140

Table 4.5: Background characteristics of the interviewees for the qualitative data...... 141



University of Ghana http://ugspace.ug.edu.gh

LIST OF FIGURES

Figure 2.1: The Safer Dx framework ……………………………………………………………63

Figure 2.2: Conceptual framework for system factors pathway to patient misdiagnosis 72

Figure 3.1: Selection criteria of the patients' records for data extraction 89

Figure 4.1: Classification of misdiagnosis =223)……………………………………………127

Figure 4.2: Pareto chart for topmost misdiagnosed major diagnostic groupings 128

Figure 4.3: The topmost misdiagnosed conditions in each of the topmost misdiagnosed major diagnostic groupings……………………………………………………...…………………130

Figure 4.4: Overall topmost misdiagnosed diseases or conditions……………………….....…...132

University of Ghana http://ugspace.ug.edu.gh

ABSTRACT

Background: Achieving high-quality healthcare that is safe, effective, efficient, patient-centered, timely, and equitable necessitates a systemic approach. Not many countries, particularly in sub-Saharan Africa, including Uganda optimally achieve this. Poor quality of healthcare characterized by inappropriate treatments, medical errors and poor outcomes has often resulted from patient misdiagnosis. An estimated 5-15% of hospitalized patients globally, are misdiagnosed posing a significant barrier to quality and safe healthcare. Misdiagnosis is particularly concerning in such resource-constrained healthcare systems as that of Uganda, where it can hinder progress towards attaining universal healthcare coverage. This study, therefore, was conducted with a general objective of establishing the prevalence of patient misdiagnosis and factors contributing to misdiagnosis among hospitalized patients in general hospitals in Uganda. The ultimate goal is to provide information that can contribute to strengthening healthcare systems for quality healthcare delivery.

Methods: The study used an explanatory mixed-method cross-sectional research design, collecting both quantitative and qualitative data, to examine misdiagnosis in Kiboga, Nakaseke, Gombe, Kayunga, and Mityana general hospitals. Stratified and simple random sampling techniques were used to sample the medical records, ensuring representativeness. Stratified random sampling considered the hospital of admission, the patient's age, and their gender to ensure a balanced representation. As part of this method, proportional allocation was used for comparable sample sizes, including children aged 0–9 and those over 10 years old. An allocation of 50% between males and females promoted balanced comparisons across genders, an essential factor in research that evaluates conditions or treatments.

University of Ghana http://ugspace.ug.edu.gh

Records of 2,431 patients admitted between July 1, 2019 and June 30, 2020 were analyzed to determine the proportion of misdiagnosed patients. The original diagnosis assigned by the clinician or diagnostician was compared to the diagnosis confirmed by a medical officer or physician on the ward. Misdiagnosis was categorized into four levels of Class I; Class II, Class III, and Class IV guided by the International Classification of Diseases version eleven (ICD-11). The Pareto principle was used to identify the most common misdiagnosed diseases and major diagnostic groupings. Logistic regression was used to analyze the factors associated with misdiagnosis, with significant variables with a *p*-value of ≤ 0.05 and their adjusted odds ratios considered as independently associated factors. In-depth interviews were conducted with eight clinical officers and seven medical officers to provide insights into the phenomenon of misdiagnosis in the hospitals. The qualitative analysis employed a deductive thematic approach, with data analyzed manually and the identified themes systematically aligned with the health system building blocks, as well as the structure, processes, and outcomes of the Safer Diagnostic framework.

Results: The study observed that 9.2% (223 out of 2,431; 95% CI of 8.1-10.3%) of patients were misdiagnosed, with 70.9% (158 out of 223) of these misdiagnosed patients classified as Class I, indicating that the wrong diagnosis and the correct diagnosis belonged to different major diagnostic groupings. Infectious or parasitic diseases (32%), digestive system diseases (12%), circulatory system diseases (11%), endocrine, nutritional, or metabolic disorders (9%), genitourinary system diseases (7%), respiratory system diseases (7%), and blood and blood-forming organ diseases (5%), were the seven most misdiagnosed major diagnostic groupings. Peptic ulcer disease, severe malaria, hypertension, gastroenteritis, and pneumonia were among the most misdiagnosed diseases. Non-communicable diseases accounted for most misdiagnosed conditions (82.9%).

University of Ghana http://ugspace.ug.edu.gh

The multivariable logistic regression analysis revealed that variables associated with misdiagnosis included; being admitted to Nakaseke hospital (1.95 times more likely; 95% CI =1.17-3.25, *P*=.01, being admitted at night (3 times more likely; 95% CI=1.81-5.02, *P*<.001), being male (1.89 times more likely; 95% CI=1.35-2.64, *P*<.001), being in the age group of 10 to 50 years and above (aOR 2.3; 95% CI=2.3-9.25, *P*<.001; aOR 8.15; 95% CI=4.18-15.89, *P*< .001; aOR 8.12; 95% CI=3.99-16.54, *P*<.001; aOR 7.88; 95% CI=3.71-16.73, *P*<.001; aOR 12.14; 95% CI=6.41-23.01, *P*<.001). Other variables associated with misdiagnosis included patients with multimorbidity (aOR 4.71; 95% CI=1.91-11.65, *P*<.001) and patients treated for uncommon diseases of admission to the hospital (aOR 2.57 95% CI=1.28-5.18, *P*<0.001). On the other hand, patients without underlying diseases were 37% less likely to be misdiagnosed (95% CI=0.43-0.91, *P*=0.015), and patients who were not referred to the hospital were 49% less likely to be misdiagnosed compared to those who were referred (95% CI=0.31-0.86, *P*=0.011).

The phenomenon of patient misdiagnosis, classification and associated factors is complex and was explained by the diagnosticians, analyzed and presented through the lenses of Safer Diagnostic Framework and health system building blocks. The issue of advancing age and its association with misdiagnosis was explained to be due to complex or uncommon diseases in such age groups, which clinicians are unfamiliar with compared to less complex and easy to diagnose diseases in children. On the other hand, the high likelihood of misdiagnosis among male patients was due to their poor healthcare-seeking behaviours, especially late reporting to the hospital when severely sick complicating the diagnostic process, and by their unfamiliarity with healthcare systems.

Human resources for health issues contributing to misdiagnosis included inadequate healthcare workforce numbers leading to work overload, shortfalls in training, and healthcare workers fatigue, especially at night. Besides, other factors contributing to misdiagnosis cited included inadequate

University of Ghana http://ugspace.ug.edu.gh

infrastructure, particularly laboratory and radiological examinations, and other diagnostic tools and technology. Several organizational or hospital factors, including suboptimal nighttime service arrangements, and the absence of a quality of care and safety culture, underscored the role of leadership and governance play in misdiagnosis. Additionally, inadequate service delivery such as lack of investigations and clinical support hamper appropriate diagnosis at night. Challenges in the patient referral process from primary healthcare facilities to hospitals, including patients being referred with incomplete referral notes, could contribute to the high risk of misdiagnosing referred patients, among other factors.

Conclusion: Misdiagnosis in the general hospitals studied remains a significant quality of healthcare and safety problem that has a complex and of multifactorial etiology; mostly attributable to seven major diagnostic groupings and 19 diseases. While the prevalence fell within global estimated ranges, it was concerning that most misdiagnoses were classified as Class I. The result of the discovery of this misdiagnosis was that significant treatment changes were needed. In the absence of any changes in patient management, especially if the misdiagnosis was not recognized, a poor outcome would have resulted. Predispositions within the leadership and governance, service delivery, medicines and health technologies, and human resources for health underpin the observed misdiagnosis occurrence in this study. To enhance patient diagnosis and treatment outcomes, health services planners, managers and implementers should prioritize this health system building blocks, with particular focus on the 19 most commonly misdiagnosed conditions and major diagnostic groups.

University of Ghana http://ugspace.ug.edu.gh

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Health systems world over aim to provide quality health care that meets professional standards and results in desired health outcomes (NAM, 2015). The Institute of Medicine (IOM) defines quality health care as services that increase the likelihood of desired health outcomes and align with current professional knowledge (Institute of Medicine (IOM), 1991). For health services to be considered of high quality, they should meet several criteria. These criteria include safety (avoiding harm to patients), effectiveness (achieving intended outcomes), efficiency (using resources effectively), being patient-centered (meeting patient needs and preferences), timely delivery, and equity (providing services to all recipients regardless of their circumstances) [(Institute of Medicine, 2001; Kohl, 2018; Newman-toker & Pronovost, 2009)]. The delivery of quality health care also requires efficient use of resources and should not harm patients (Cylus et al., 2016)

Health care systems in many countries struggle to provide optimal, safe, timely, and quality diagnostic services to their citizens (Kohl, 2018; Picarillo, 2018). A retrospective record review in eight low-income countries, including Egypt, Jordan, Kenya, Morocco, Tunisia, Sudan, South Africa and Yemen revealed that diagnostic errors occurred in 19.1% of the records making it the second most prevalent medical error (Wilson et al., 2012). Mahumud et al. (2016) similarly reported that over 850,000 diagnostic errors occurred in low income and middle-income countries leading to death. Yadav et al. (2021) discovered that diagnostic availability in low-and middle-income countries such as Bangladesh, Haiti, Malawi, Namibia, Nepal, Kenya, Rwanda, Senegal, Tanzania, and Uganda were critically low, and wide variations (1.2% to 91.6%) existed. This is

University of Ghana http://ugspace.ug.edu.gh

likely to lead to unmet healthcare needs for patients and causes inaccurate diagnoses, inappropriate treatments, and medical errors (Das et al., 2018). Diagnostic errors pose a significant barrier to quality and safe healthcare services hindering progress towards achieving the goal of universal healthcare coverage (NAM, 2015; Kohl, 2018).

Patient diagnosis is a vital part of providing quality healthcare and is done by health workers in primary care settings (Croskerry & Nimmo, 2011; Hausmann et al., 2016; NAM, 2015b). The National Academy of Science and Medicine (NASM) notes that a diagnosis made when a patient arrives at a healthcare facility determines the course of care they will receive (NAM, 2015). Some researchers noted that diagnoses could sometimes be wrong, leading to diagnostic errors, which occur in 1–55% of cases depending on the disease and represent the second most common adverse event after treatment errors (Ely et al., 2012; Zwaan et al., 2013a).

Misdiagnosis is one of the top ten emerging healthcare risks and can lead to unnecessary hospital visits and readmissions, incorrect treatment, and unnecessary procedures (Schiff et al., 2009; Youngberg, 2016). The World Health Organization (WHO) has called for measures to reduce misdiagnosis and improve patient care (WHO, 2016). These errors can occur at any stage of the diagnostic process and affect anyone at some point in their lifetime (Singh et al., 2016; Singh, et al., 2014).

Improving diagnostic accuracy to prevent misdiagnosis is becoming more widely recognized among healthcare providers and patients (Wachter, 2014). Patients and healthcare providers must prioritize an accurate and timely diagnosis to guide subsequent treatment (Zwaan et al., 2016). Making an accurate and timely diagnosis has become a litmus test of a physician's abilities, skills,

University of Ghana http://ugspace.ug.edu.gh

competencies, and self-image (Graber et al., 2012). The speed with which a diagnosis is reached and the accuracy of the diagnosis determine how quickly a patient recovers. As a result, patients prioritize diagnostics over other aspects of healthcare (Chatterjee, et al., 2016). A right diagnosis gives the patient more confidence and trust that the rest of their care will succeed.

Misdiagnosis can spread infectious diseases to those who encounter the affected patient, health workers, and hospital. In low- and middle-income countries, misdiagnosis has a negative impact on care and patient safety, and more research is needed to determine the scope of the problem (Upadhyay et al., 2015; Wilson et al., 2012). In situations where proper treatment is available, misdiagnosis is regarded as the most undesirable possible outcome, and it is therefore, critical to take precautions to avoid it (Khullar et al., 2016).

The focus on improving medical treatments, drugs, and technologies has left misdiagnosis unaddressed. There is a lack of attention paid to misdiagnosis in patient safety programmes, making it difficult to tackle (Shenvi & El-kareh, 2015). To address this issue, it is necessary to determine the extent of the problem, what factors in the healthcare system contribute to misdiagnosis, the extent to which patients are affected when misdiagnosis occurs, and the steps that lead to misdiagnosis.

This research, therefore, was set out to establish the magnitude of the problem of misdiagnosis and to establish factors associated with its occurrence in general hospitals in Uganda. To achieve this, the study used an explanatory mixed-method cross-sectional study design with quantitative and qualitative methods approach in which patient records were reviewed and analyzed to establish how big the problem was, classify the extent of misdiagnosis and establish the various factors associated with the problem. Health workers then provided explanations to the factors associated with

University of Ghana http://ugspace.ug.edu.gh

misdiagnosis. The findings from this study further aim to contribute toward addressing these objectives/questions by informing the development of more robust diagnostic strategies, which could ultimately improve patient outcomes and optimize resource use.

1.2 Problem statement

The problem of misdiagnosis is documented across diverse healthcare systems, with global estimates showing that 5–15% of hospitalized patients suffer from misdiagnosis, contributing to poor health outcomes and diminished quality of care (Schiff et al., 2009). While underreporting of misdiagnosis is common in Sub-Saharan Africa, evidence suggests that misdiagnosis is a growing challenge due to inadequate diagnostic services and human errors (NAM, 2015). For example, HIV misdiagnosis rates range from 0.1% to 6.6% (Johnson et al., 2017). On the other hand, for one-third of children in the region, bacterial infections are frequently misdiagnosed as severe malaria leading to delays in life-saving antibiotic treatment (White et al., 2022).

Patient misdiagnosis is exclusively critical in Uganda. For example, 62% of febrile illnesses in rural areas are misdiagnosed as malaria, and 30.6% of HIV-associated lymphoma cases are wrongly diagnosed and managed as tuberculosis (Buyego et al., 2017; Ghai et al., 2016; Masamba et al., 2016). Such misdiagnoses in low-income countries are exacerbated by the lack of diagnostic capacity, particularly where facilities often fail to detect chronic or rare conditions (Newman-Toker et al., 2019). Mbonye et al. (2014) emphasize that fewer than 30% of diagnoses are backed by laboratory investigations in Ugandan primary healthcare settings reflecting a critical gap in patient diagnosis. Misdiagnosis is further exacerbated by human error, whether through wrong test interpretations, inappropriate test selection, or communication breakdowns between clinicians and patients (Singh et al., 2013; Singh et al., 2019).

University of Ghana http://ugspace.ug.edu.gh

The consequences of misdiagnosis are far-reaching, with profound implications for patients and healthcare systems alike. Over seven million child deaths have been linked to misdiagnosis globally (Aase, 2013). Misdiagnoses not only delay appropriate treatment but can lead to adverse events like incorrect surgeries, re-admissions, disabilities, or even death (Khullar et al., 2016; Campione et al., 2018). The problem is further compounded by the inappropriate use of medications, which can reduce drug efficacy and lead to increased stress and suffering for patients and families (Mahumud et al., 2016a; Graber, 2013; Rutebemberwa et al., 2013).

Misdiagnosis also plays a significant role in the spread of communicable diseases such as TB and HIV and distorts health statistics necessary for proper planning and resource allocation (Singh et al., 2017; Neshati et al., 2018). There is an urgent need to establish the burden of patient misdiagnosis to inform strategies aiming at improving diagnostic capabilities. This information will also help in mitigating the consequences of misdiagnosis, and address the underlying challenges contributing to patient misdiagnosis (Khullar et al., 2016; Singh et al., 2019).

1.3 Justification of the study

The current universal healthcare coverage agenda is gradually generating considerable interest in patient diagnosis (Das et al., 2018). For instance, quality diagnosis is paramount if universal health coverage is to be attained (Kovacs et al., 2020). Das et al. (2018) also affirmed that the implied health outcomes in the universal health coverage agenda could only be achieved by health systems that accurately diagnose or manage patients. This is alongside the notion that, while a patient may have physically sought and received treatment, if the patient's diagnosis was incorrect, this will be tantamount to no care received (Akachi & Kruk, 2017). Leslie et al. (2017) studied countries considered to be high mortality and concluded that misdiagnosis resulted in poor health outcomes and patient harm, making universal healthcare coverage difficult. This supports the fact that

University of Ghana http://ugspace.ug.edu.gh

physical access to care is not enough to guarantee comprehensive healthcare coverage if the right diagnosis is not arrived at.

There is insufficient research to help health workers and policymakers fully understand the impact of misdiagnosis on clinical practice and healthcare service delivery in low-income countries. Despite efforts in high-income countries to document the extent of misdiagnosis, more research in low-income countries is required to fully understand this issue (Mahumud, et al., 2016; Zwaan & Singh, 2015). This study aimed to address gaps in the understanding of factors associated with patient misdiagnosis in healthcare in Uganda. This study was intended to inform processes aimed at improving diagnosis by gathering empirical evidence from the sites where the diagnosis was performed, analyzing it, and synthesizing this information to guide initiatives aimed at avoiding harm to patients caused by misdiagnosis.

There are currently no reliable estimates on the number of misdiagnosed patients in Ugandan hospitals. This study aimed to add to the existing methods for determining the magnitude of misdiagnosis by calculating the proportion of wrongly diagnosed patients. This study may provide information on the scope of the problem and classifies misdiagnoses to inform health practitioners about the most misdiagnosed diseases and their prevalence (Avery, 2003). Knowing and tracking the prevalence of misdiagnosis over time and identifying factors associated with it in Ugandan hospitals may lead to the investigation of the causes behind changes in trends. This may enable the development of the most effective methods for improving the diagnosis of various diseases and disease groups. This study provides information on possible interventions for individuals dealing with diagnosis and misdiagnosis.

University of Ghana http://ugspace.ug.edu.gh

1.4 Reflexivity on framing the study

The researcher's medical background and interest in healthcare quality and safety underpinned this study. This included the research questions, conceptual framework, and methods used. As a newly qualified clinician, the researcher knew many diseases but lacked experience in managing them. After five years of practical experience, the researcher gained considerable knowledge of diagnosing common illnesses but had a diminished understanding of diagnosing rare illnesses. Fear of being perceived as incompetent by peers and patients often presented diagnostic challenges. The persistence of these difficulties contributes to misdiagnosis and can lead to disastrous outcomes such as patient deaths.

1.5 Objectives of the study

The following general and specific objectives guided the conduct of this study.

1.5.1 General objective

To determine the prevalence of and factors associated with inpatient misdiagnosis in selected general hospitals in Central Uganda.

1.5.2 Specific objectives

The specific objectives of the study were;

a) To determine the prevalence of misdiagnosis among inpatients in general hospitals in Central-Uganda
b) To identify conditions and diseases most frequently misdiagnosed in general hospitals in Central Uganda
c) To assess the association between disease-related factors and patient misdiagnosis in general hospitals in Central Uganda

University of Ghana http://ugspace.ug.edu.gh

d) To examine the association between patient related factors and patient misdiagnosis in general hospitals in Central Uganda

e) To assess the association between health system related factors and patient misdiagnosis in general hospitals central Uganda

f) To explore health workers' perception of patient misdiagnosis in general hospitals in general hospitals in Central Uganda

1.5.3 Research questions

a) What is the prevalence of misdiagnosis among inpatients in general hospitals in Central Uganda?

b) Which medical conditions or diseases are commonly misdiagnosed in general hospitals in central Uganda?

c) What is the association between disease-related factors and patient misdiagnosis in general hospitals in Central Uganda?

d) What is the association between patient related factors and patient misdiagnosis in general hospitals in Central Uganda?

e) What is the association between health system related factors and patient misdiagnosis in general hospitals in Central Uganda?

f) What is health workers' perception of patient misdiagnosis in general hospitals in Central Uganda?

1.6 Outline of the thesis

This thesis is divided into chapters. The first chapter is the introduction where there is an analysis of misdiagnosis from global perspectives in general and in Ugandan hospitals in particular. It

University of Ghana http://ugspace.ug.edu.gh

outlines five key areas for investigation. These include the prevalence of misdiagnosis among admitted patients, misdiagnosis classification, predictors and factor associated with patient misdiagnosis. The background, problem statement, and rationale for studying misdiagnosis are also discussed. The researcher's personal experiences as a clinician and quality and safety advocate inspired the study. The second chapter contains a review of the literature, theoretical perspective and a conceptual framework. The methodology is described in Chapter three. The results are presented in Chapter four. The relationship between the findings and literature and the theoretical perspective applied has been discussed in Chapter five. Chapter six provides the summary, conclusion of the study and offers recommendations.

University of Ghana http://ugspace.ug.edu.gh

CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Introduction

Chapter two provides a comprehensive literature review, exploring existing research and theoretical frameworks related the factors contributing to misdiagnosis among hospitalized patients. Section 2.2 discusses the concept of quality of care and how misdiagnosis relates to various aspects of quality of care. Section 2.3 discusses misdiagnosis. Section 2.4 provides context by delving into Uganda's healthcare system and delivery methods. The definition and measurement of misdiagnosis are critical aspects of the study. The methods for doing so are described in Section 2.5. Section 2.6 explores misdiagnosis prevalence. Section 2.7 investigates classification of misdiagnosis. Factors related to patients and diseases that contribute to misdiagnosis are discussed in sections 2.8 and 2.9. The impact of the health system and care delivery context of misdiagnosis are covered in section 2.10. The study is guided by two theoretical frameworks, the "Safer Dx Framework" and the "Health System Building blocks," which are reviewed in Section 2.11. The conceptual framework, which is synchronized with the two guiding theoretical frameworks, is presented in Section 2.12. Finally, Section 2.13 summarizes the chapter and highlights any gaps in the literature that were identified during the review.

2.2 Quality of Care / Patient Safety

The World Health Organization has set a goal of providing universal healthcare coverage to all citizens worldwide by 2030, ensuring they have access to high-quality, safe healthcare without financial strain (World Health Organization, 2021a). However, this goal is jeopardized by poor healthcare quality in some countries, which accounts for more than 60% of deaths in low- and

University of Ghana http://ugspace.ug.edu.gh

middle-income countries (Kruk et al., 2018). Poor patient safety also raises hospital costs due to wasted resources and lost productivity (Mcnutt et al., 2012).

A correct diagnosis is essential for providing high-quality healthcare services, but determining the correct diagnosis for a patient can be difficult and does not always proceed as planned (Best, 2018a; Epstein, 2019a; NAM, 2015a). When diagnostic services are inadequate, misdiagnosis is a significant indicator of diagnostic errors (Sears et al., 2015). Reduced diagnostic errors are an important part of improving healthcare quality and patient safety (Singh et al., 2019). Misdiagnosis research is required to improve diagnosis quality while also reducing the financial burden of unsafe care on Uganda's health system.

2.3 Patient misdiagnosis

A misdiagnosis occurs when a patient's diagnosis is incorrect; it is the failure to accurately explain a patient's signs, symptoms, or illness (NAM, 2015). Kirch and Scafii (1994) also point out that a misdiagnosis is considered if a diagnosis assigned could not be considered present if an autopsy were performed. Misdiagnosis is generally grouped under diagnostic error, which is defined as the failure to correctly and timely identify a patient's problems, or the failure to explain and communicate the problem to the patient (Schiff et al., 2009; Zwaan & Singh, 2015). Diagnostic error includes misdiagnosis (incorrect diagnosis), missed diagnosis (failure to make a diagnosis), and delayed diagnosis (taking too long to make a correct diagnosis) [(NAM, 2015)].

The three types of misdiagnoses are false positive misdiagnosis, false negative misdiagnosis, and equivocal misdiagnosis (Kirch et al., 2004). False negative misdiagnosis occurs when a diagnostician indicates that a disease does not exist when it does, causing a patient to miss out on necessary treatment (Kirch & Scafii, 1994). A false positive misdiagnosis occurs when a

University of Ghana http://ugspace.ug.edu.gh

diagnostician indicates the presence of a disease when it is not present, resulting in unnecessary treatment for the patient (Kirch & Scafii, 1994). Indecisive misdiagnosis involves assigning disease symptoms and signs as a diagnosis resulting in a patient not receiving definitive treatment (Kirch et al., 2004).

2.4 Uganda's health system

The healthcare system in Uganda is overseen by the Ministry of Health and organized in a hierarchical manner with seven levels of services, in accordance with the country's civil administration system from local to national levels. The Ministry of Health oversees overall management and policy development in the healthcare sector (Ministry of Health, 2014).

Health services delivery

The delivery of health services in Uganda is divided into three categories, with 75% being provided by the government, 20% by Private Not for Profit (PNFP) facilities, and 5% by Private for Profit (PFP) facilities (Ministry of Health, 2021a). The first point of contact with the healthcare system is through a Village Health Team (VHT), where a member of the community acts as a drug distributor and health promoter. The number of VHTs in a village is determined by its population size. The next six levels provide various primary healthcare services, including both curative, promotive, preventive, and rehabilitative care, depending on their capacities. At the Health Centre II (HC II) level, located at the parish level, an enrolled nurse with the help of an enrolled midwife provides outpatient clinic services and can treat common illnesses such as malaria and pneumonia, as well as offer antenatal care.

INTEGRI PROCEDAMUS

The HC III is located at the sub-county level and has 18 employees. It is an outpatient facility that includes a maternity center and a basic laboratory. At the county or parliamentary constituency

University of Ghana http://ugspace.ug.edu.gh

level, the HC IV serves a population of over 200,000 people and provides all services offered by the HC III, but it also has separate wards for children, adult male, and female patients, and it can admit patients. It has a large operating theatre for obstetric emergencies and is the first level of health care with a medical officer.

The general hospital, with 100 inpatient-bed capacity is the next level of the healthcare system, which is intended to serve a population of 500,000 people and should ideally be present in every district (Institute for Health Metrics and Evaluation (IHME), 2014a). It provides all services that HC IV provides, as well as specialized clinics such as diabetic, HIV/AIDS, dental, nutrition, and mental health clinics. It also serves as a referral center for lower-level primary care facilities, as well as a primary healthcare facility for the surrounding communities. By the 2020/2021 fiscal year, Uganda had 180 general hospitals, 139 of which were government owned.

The regional referral hospital is the sixth level of regional healthcare facilities, serving a population of 2 million people. It is a specialized hospital with a variety of specialists and consultant medical officers, as well as 14 regional referral hospitals. National referral hospitals, which are five in number and serve as referral facilities for lower-level health facilities, are the highest level of healthcare facilities. The capital city of Uganda, Kampala, is home to all five national referral hospitals.

Patients are admitted to outpatient departments, which also serve as emergency departments. A clinical officer, an allied health professional with a diploma or degree in clinical medicine and community health from a clinical training school, usually conducts the admission process. On rare occasions, however, the diagnostic process may be carried out by nurses, students undergoing practical training in the hospital, other allied health professionals, or a medical officer.

University of Ghana http://ugspace.ug.edu.gh

In Uganda, general hospitals provide both outpatient and inpatient care, including surgical services (Ministry of Health, 2019b). The total number of admissions in Ugandan hospitals in the 2022/2023 fiscal year was 821,343, with pediatric admissions accounting for 35-40% of the total admissions (Ministry of Health, 2023). Malaria, pneumonia, respiratory infections, acute diarrhea, injuries, anaemia, septicaemia, urinary tract infections, gastro-intestinal disorders, and road traffic accidents accounted for 66.5% of total admissions in Ugandan healthcare facilities (Ministry of Health, 2017a).

Health leadership and governance

In Uganda, the Ministry of Health oversees healthcare in the country, providing policy direction, and ensuring quality healthcare for all citizens and non-citizens alike (Ministry of Health, 2013). The ministry has a quality assurance department to ensure that quality care is provided. The primary healthcare facilities and general hospitals operate under a decentralized governance system in which each level reports to the local administration that governs it (Mukasa, 2012a). The decentralization policy has resulted in the delegation of health-care stewardship to the district level, led by the District Health Officer (Ministry of Health, 2011). The district local council appoints a Medical Superintendent to manage the general hospital, who is overseen by the Hospital Management Committee (Mistry of Health, 2013).

Health workforce

The 2017/2018 human resources for health staffing audit report showed that general hospitals in Uganda had an overall staffing level of 76%, while the study hospitals had an overall staffing level of 84% (Ministry of Health, 2017b). Clinical officers, laboratory staff, nurses, and doctors are among the critical personnel required in Uganda for the diagnostic process and treatment of

University of Ghana http://ugspace.ug.edu.gh

patients. Their national staffing levels were 104%, 102%, 100%, and 63%, respectively (Ministry of Health, 2017b). The study settings, Mityana, Gombe, Nakaseke, Kiboga, and Kayunga hospitals had general staffing levels of 108%, 66%, 96%, 78%, and 73%, respectively (Ministry of Health, 2019a).

Healthcare financing

The total spending on health in Uganda during the 2019/2020 fiscal year was 7.5 trillion shillings (2.4 billion US dollars). The government provided 2.6 trillion shillings (34.7%) of this funding, while individuals contributed 41%, mainly through out-of-pocket payments (Ministry of Health, 2020a). General hospitals are primarily funded by the government and donors, but some of them also receive revenue from private payments and private health insurance (Ministry of Health, 2015). Although the percentage of patients who pay out of pocket for government health services was only 8%, overall out-of-pocket spending was 40% (Institute for Health Metrics and Evaluation (IHME), 2014a; Kwesiga et al., 2020). Patients may need to purchase drugs and pay for tests from private sources that are not covered by the government (Mukasa, 2012a). Some general hospitals offer private wards for in-patient services with out-of-pocket payments, but there is no public health insurance and only 1% of the population has private health insurance (Dowhaniuk, 2021; Ministry of Finance Planning and Economic Development, 2016).

Access to essential medicines and hospital infrastructure

The Ugandan government funds general hospitals based on a yearly budget to purchase necessary medicines and supplies on the essential drugs list (Ministry of Health, 2019b). The hospitals use a pull system in which they request the drugs they require, which are then delivered bimonthly by the National Medical Stores (NMS). However, at other times drugs run out and the availability of

University of Ghana http://ugspace.ug.edu.gh

medicine to treat common conditions becomes limited. Most hospitals have enough medicine to treat non-infectious diseases (Ministry of Health, 2014). The majority of Ugandan general hospitals lack advanced diagnostic equipment, with only 24% having all the necessary equipment. Although the majority of hospitals have laboratory services, 83% of them can only provide half of the services required (Ministry of Health, 2014).

Health information systems

In Uganda, there is both a paper-based and an electronic Health Management Information System (HMIS) in place. Health workers use the paper-based system for patient management on daily basis and the information collected is then compiled, analyzed and stored in the computerized District Health Information System version 2 (DHIS2) (Ministry of Health, 2012). The DHIS2 generates reports that are submitted to the district and national levels on a weekly, monthly, or quarterly basis and are used for management and research purposes. Data on adverse drug events collected as part of patient safety measures, while private not-for-profit hospitals under the Uganda Catholic Medical Bureau (UCMB) have an error reporting mechanism (Katongole et al., 2015; Ministry of Health, 2010). All maternal, neonatal, and perinatal deaths require death audits in all hospitals, however, there is currently no mechanism for reporting diagnostic errors in government hospitals (Ministry of Health, 2017a).

2.5 Establishing and measuring misdiagnosis

Various methods have been used to measure diagnostic errors, including autopsies, surveys, record reviews, medical malpractice claims, and insurance claims (Kuijpers et al., 2014; Mcdonald et al., 2013).

University of Ghana http://ugspace.ug.edu.gh

Autopsy

The autopsy, also known as a post-mortem examination, has long been regarded as the gold standard for detecting and quantifying diagnostic errors (Kuijpers et al., 2014). It is carried out to ascertain the cause of death and to identify any discrepancies between the clinical diagnosis and the autopsy results (Thorning, 2001).

However, relying solely on autopsies to improve healthcare may be ineffective due to the global decline in the use of autopsies as a diagnostic error measurement tool (Mcdonald et al., 2013). This may not be the most effective method for studying diagnostic errors in regions such as Africa, where only a small percentage of deaths undergo autopsies (Liu et al., 2018; Thorning, 2001). Furthermore, because autopsies are performed after death, it is difficult to use them to improve practices (Graber, 2013).

Because of the risk of misclassifying the cause of death, verbal autopsies, which involve asking the deceased's relatives about the cause of death rather than physically examining the body, are discouraged in Ghana (Fobil et al., 2011; Ordi et al., 2009). Autopsies can detect conditions that would not have been suspected in life, but many of these findings are clinically irrelevant and do not result in learning, which may contribute to their decline in use for detecting medical errors (Singh, 2018).

Medical claims data

Medical malpractice claims, which are often large records containing information from patients or caregivers seeking compensation for perceived poor care, provide useful data for studying diagnostic errors (Singh et al., 2012; Wang et al., 2017; Zwaan et al., 2013b). There are two types of claims: tort litigation, in which compensation is given after medical negligence is proven, and

University of Ghana http://ugspace.ug.edu.gh

"no fault," in which patients are compensated for errors without having to prove fault (Mcpherson et al., 2017; U.S. Chamber Institute for Legal Reform, 2018). However, using medical malpractice claims to study diagnostic errors is controversial for several reasons. One reason for this is that many diagnostic errors do not result in litigation, so claims may not accurately reflect the extent of misdiagnosis (NAM, 2015).

Claims can also be unreliable and may present certain healthcare issues, including portraying certain healthcare organizations as more prone to errors, even if this is not due to organizational weaknesses (Ferver et al., 2009; NAM, 2015b; Wang et al., 2017). There are also differences in where claims originate, with some studies finding more claims in public facilities and others finding more claims in private facilities (Birks et al., 2018; Chodos, 2015; Kadimba et al., 2015). The reasons for this variation differ, but access to compensation and confidentiality laws are both factors contributing to the variation (Giraldo et al., 2016).

Health insurance claims

Diagnostic errors in the healthcare system can be measured using health insurance claims (NAM, 2015). Insurance claims are statements written by either physicians, surgeons or administrators on behalf of service providers listing the cost of healthcare services provided for which payment is being sought from insurers (Ferver et al., 2009). Insurance claims data can provide valuable information on patients' interactions with the healthcare system over time, including the occurrence of diagnostic errors (Mogyorosy & Smith, 2005). The information is stored in electronic databases and can provide insights into patients' treatment experiences over the course of their lives (Blewett et al., 2018). Ferver et al. (2009) supplement that claims data can be used

University of Ghana http://ugspace.ug.edu.gh

without authorization from patients, hence, helping to obtain information that would perhaps, not have been disclosed if patients' surveys were to be used.

However, the use of insurance claims to assess safety in healthcare has been criticized. For starters, the claims are mostly based on Diagnosis Related Groupings, making disease-specific data difficult to obtain (Ferver et al., 2009). For example, insurance data were found lacking, characterized by poor coding and storage as per a study conducted in Ghana, Kenya, Nigeria, Tanzania and Uganda (Carapinha et al., 2011). Second, health workers are frequently too preoccupied with their work to complete claims, resulting in a lack of clinical details needed to measure the outcomes of interest (Wilson & Bock, 2012).

Furthermore, insurance claims data are regarded as unreliable for health services research due to incompleteness, limited content, and late preparation (Ferver et al., 2009; Romano et al., 2010; Whicher et al., 2018). Besides, many African countries are still in the early stages of using health insurance data to improve quality and patient safety (World Bank, 2016). As a result, for meaningful quality and safety research, safety and quality authorities recommend supplementing insurance claims data with other relevant data sources, such as electronic medical records (Bruce & McDonald, 2007).

Patients and health workers' surveys

Surveys of healthcare providers and patients can reveal individual and systemic problems that contribute to diagnostic errors (Clinical Excellence Commission, 2015; Sarkar et al., 2013; WHO, 2016). Clinicians and physicians, who are at the forefront of the diagnosis process, can provide insight into the frequency and causes of diagnostic errors (Graber, 2013; Graber et al., 2017a).

University of Ghana http://ugspace.ug.edu.gh

Written questionnaires, phone calls, and web-based interviews can all be used to conduct surveys (NAM, 2015). Patients who have had diagnostic errors can also provide feedback on the diagnosis they received as well as any factors that may have contributed to the misdiagnosis (NAM, 2015).

However, surveys are not considered the best method for studying diagnostic errors due to potential design flaws, recall bias, and instrument validity concerns (Male et al., 2017). Recall bias is particularly a problem because patients and practitioners frequently only recall severe incidents (The Health Foundation, 2013). The use of standard and validated survey instruments is thus, recommended when conducting surveys to measure diagnostic errors (Browne et al., 2010). However, the usefulness of surveys depends on the setting and the willingness and ability of patients to discuss their experiences (The Health Foundation, 2013). Therefore, great care and thoughtfulness must be given to the design of the surveys and the quality of the tools used to ensure reliable results.

Using records review

A popular approach to determining diagnostic errors is medical record review, also known as Healthcare Records Review (HRC). In contrast to autopsies, the data has already been gathered, so there is no need to wait for patients to die to determine the true disease from which they suffered (Schiff et al., 2005). As a result, some regard it as the gold standard for detecting diagnostic errors and close calls (Cheraghi-Sohi et al., 2015; Reis et al., 2013; Singh et al., 2012). This method involves manually or electronically retrieving patient data from previous events (Worster & Haines, 2004a). Electronic medical records (EMR) are preferred due to their ease of use, low cost, and quick review process (Akanbi et al., 2014; Jawhari et al., 2016). The electronic medical records can also be used to analyze large amounts of data and provide hints for missing information

University of Ghana http://ugspace.ug.edu.gh

(Stausberg et al., 2003). However, both manual and electronic methods have advantages and disadvantages when it comes to quality of care and patient safety research.

Paper-based medical records (PBMRs) are sometimes preferred in healthcare quality research because they provide a more reliable source of data for individual-focused studies (Worster & Haines, 2004a). Th is because electronic medical records occasionally miss key patient data, including age, sex and many other demographic and treatment related data relevant to specific research variables that can only be found in paper records. However, the use of electronic medical records for research in low- and middle-income countries, especially in Sub-Saharan Africa, has been widely discouraged (Michel, 2003). This is because most of these systems were originally designed for management rather than research purposes, and therefore, may not provide the level of detail and quality necessary for research (Worster & Haines, 2004).

Furthermore, most countries in sub-Saharan Africa are in the process of implementing electronic medical records, but the transition is still ongoing (Akanbi et al., 2014; Odekunle et al., 2017; Syzdykova et al., 2017). Electronic medical records systems in sub-Saharan African are also underdeveloped, raising concerns about their reliability for research purposes (Cilliers & Katurura, 2017). Many of these electronic medical systems remain dependent on paper records and are often limited to documenting specific diseases, such as HIV and tuberculosis (Akanbi et al., 2014; Jawhari et al., 2016). A study in Ethiopia, revealed that paper-based records were more reliable for antiretroviral data because they were more complete than electronic records (Abiy et al., 2018).

University of Ghana http://ugspace.ug.edu.gh

In sub-Saharan Africa, paper-based medical records are often preferred over electronic systems due to the challenges posed by electronic records (Jawhari et al., 2016). Despite this preference, paper-based records are not without limitations. Reis et al. (2013) highlight that these records cannot be fully relied upon for measuring diagnostic errors, as they may be incomplete or inconsistent. Singh et al. (2012) further points out that paper-based systems are costly, time-consuming, and may lack critical details necessary for accurately assessing diagnostic errors. However, Cesare and Were (2022) found thatin Kenya, paper-based records remain the favoured choice for quality and safety research, as they are better equipped to address missing data issues often found in electronic records. In spite of their deficiencies, paper-based records are the preferred option for diagnostic error research because they are reliable in handling incomplete information, and they are widely available.

Methods of records review data extraction

In healthcare quality research, the two main methods for retrieving data from medical records are explicit and implicit methods (NAM, 2015). The implicit method is based on the reviewer's expertise in extracting data from medical records and their personal expertise in the assessment of the quality of care being investigated (Ashton et al., 1999). The explicit method, on the other hand, entails extracting data from medical records using predetermined criteria for a specific healthcare process and does not necessitate the data extractor being an expert in the process being studied (Weingart et al., 2002).

INTEGRI PROCEDAMUS

These two methods have varying degrees of reliability and validity (Van Melle et al., 2018). The implicit method has been criticized for being subjective because the results can be influenced by

University of Ghana http://ugspace.ug.edu.gh

the reviewer's beliefs, experiences, attention to detail, and knowledge (Weingart et al., 2002). The bias is magnified if the reviewer has prior knowledge of the case under consideration (Hutchinson et al., 2010; NAM, 2015b). The implicit method is also criticized for introducing bias by relying on the judgment of an expert reviewer, whereas the explicit method is criticized for being less sensitive in capturing safety incidents since it does not provide the reviewer room for picking any incident outside the already set criteria (Camacho & Rubin, 1998).

Despite the criticisms, there is no clear preference when it comes to the quality of record reviews. To maximize the benefits and mitigate the limitations of each method, the authors recommend using both approaches concurrently (Camacho & Rubin, 1998). Combining multiple methods is thought to be the best approach for measuring diagnostic error (The Health Foundation, 2013). For example, record reviews, surveys of health professionals and patients, and in-depth interviews may provide a more comprehensive understanding of diagnostic error (Ayatollahi et al., 2009).

2.6 Prevalence of misdiagnosis

This section presents an analysis of the prevalence of misdiagnosis and associated measurements of diagnostic errors based on the literature. Even though diagnostic error research has often taken a disease-specific approach, a general understanding of the magnitude of misdiagnosis among inpatients has eluded contemporary research. It is for the same reason that attempts to establish the magnitude of misdiagnosis are criticized for underestimating the problem (Slawomirski et al., 2017). A study on the incidence of diagnostic error in medicine also reported that variations occur in measuring the magnitude of diagnostic error based on the methodology used in the various studies (Zwaan et al., 2013). Higher rates of misdiagnosis are often reported with autopsy than any other method (Best, 2018b).

University of Ghana http://ugspace.ug.edu.gh

In diseases such as cancer, tuberculosis, heart diseases and complications related to HIV/AIDS, wrong diagnosis has been reported to occur in 10-50% of the cases (Graber, 2013). The World Health Organization hints that diagnosis is likely to be wrong in 10-15% of the patients admitted in healthcare settings (WHO, 2016). The National Academies of Sciences, Engineering, and Medicine (NASEM) observed that misdiagnosis accounted for 6 to 17% of adverse events in hospitals (NASEM, 2015). On the other hand, Edwards et al. (2017) report that 10% of patients' deaths are attributed to misdiagnosis. It is for the same reason that a call to intensify research on diagnostic process to bring to light the quality of diagnostic performance has been made (Upadhyay et al., 2015).

2.7 Classification of misdiagnosis

The classification of misdiagnosis is intended to guide healthcare practitioners on being cognizant of the diagnostic outcomes in the hospitals, including the extent to which the outcomes may have been misdiagnosed. The motivation to explicitly have a distinct classification of misdiagnosis derives from the suggestion that to develop strategies for diagnostic improvement, the need for developing error classification by experts in the science of diagnostic error was indispensable (Newman-toker & Pronovost, 2009). Cooper et al. (2018) equally stress that the classification systems may help to disclose the patient outcomes that could be expected. It further helps guide the healthcare managers and practitioners on the possible response actions to take. The classification of error by the World Health Organization has majorly centred on categorizing the degree of harm that results from the error committed (Cooper et al., 2018). Southern et al. (2016a) have also recommended the use of the International Classification of Diseases (ICD) to classify patient outcome.

University of Ghana http://ugspace.ug.edu.gh

The Goldman criteria has been the major and most used classification of diagnostic error, especially when discrepancies occur between clinical and pathological causes of death (Sblano et al., 2014; Tukaram et al., 2016). Four classes are used, including class I, II III and IV. Class I refers to a crucial diagnostic error where a key diagnosis that could have altered treatment was missed, potentially resulting in harmful outcomes, even death while the class II classification is a major discrepancy or omission of a disease condition resulting in an uncertain effect on death (Fares et al., 2011). Class III Goldman criterion has been defined as an incurable disease, non-life threatening but was not responsible for the death of the patient while class IV involves not easily diagnosable, non-life-threatening conditions (Tukaram et al., 2016).

The Goldman criteria have been modified in some studies to classify the degree of discrepancy between the clinical diagnosis and autopsy diagnosis where the modification is done to indicate severity of diagnostic error that occurred (Ordi et al., 2009, 2019; Sblano et al., 2014). For example, a study in Mozambique on the discrepancy between autopsy and clinical diagnosis aimed to establish the actual cause of maternal death, found that four types of classifications were assigned (Ordi et al., 2009). Ordi et al. (2009) used a classification of class I and class II for major discrepancies. A class I discrepancy was one in which if a true disease or condition had been known earlier, perhaps life would have been saved or prolonged if the true diagnosis had been earlier detected and the right patient management prescribed. A class II major discrepancy was one in which even if a true diagnosis had been made, it would not have prevented death while class III was assigned for minor discrepancies and would have been treated and death averted (Fares et al., 2011). Goldman's criteria for diagnostic error serve as a framework to evaluate the severity of

University of Ghana http://ugspace.ug.edu.gh

misdiagnoses. By integrating this with the International Classification of Diseases (ICD), multiple diagnostic errors can be categorized and assessed more comprehensively.

2.7.1 Major diagnostic groupings and diseases accounting for common misdiagnosis

A Pareto analysis has been used in quality improvement domains to identify the processes contributing to the undesired quality problem (Harel et al., 2016). With this analysis, a few (specifically 20%) of the causes are responsible for 80% of the outcomes or effects in a system (Picarillo, 2018a). Hence, a few of the diseases and diagnostic groupings are contributing to the largest proportion of the misdiagnosis that are noticed in the hospitals. Newman-Toker et al. (2019) on the other hand, used the International Classification of Diseases diagnostic 9th version codes to establish the leading seriously misdiagnosed major groupings from malpractice claims in the United States of America. This classification established that the "big three" i.e., vascular diseases, infections and cancers diagnostic groupings were responsible for the serious related harms. Like many other low-income countries, Uganda lacks a definition of rare diseases (Baynam et al., 2020). This thesis research thus, used the categorization of uncommon diseases, that is, arrived at using both the Pareto principle and the diagnostic grouping.

2.8 Factors associated with misdiagnosis

This section presents an analysis of factors, which could associate with misdiagnosis based on current literature. These relate to patient-related factors, drug-related factors, and health system related factors.

University of Ghana http://ugspace.ug.edu.gh

2.8.1 Patients' related factors associated with misdiagnosis

Different patients are more likely to be misdiagnosed compared with others. Demographic characteristics such as age, sex, ethnicity, and income status of a patient may influence the occurrence of misdiagnosis. Some of the socio-demographic characteristics of patients, which may influence a misdiagnosis are presented below.

Age of patient and misdiagnosis

Age influences misdiagnosis in several forms. For example, for the same disease condition, children are more likely to be misdiagnosed compared with adults (Epstein, 2019b). It is also suggested that misdiagnosis tends to be much higher among children compared with adults because children tend to present with diseases with non-specific symptoms compared with adults (Singh et al., 2017a). Unlike adults who may have followed their health life for some time, hence, can give an account of it when ill-health sets in, children do not have what it takes to explain to the health professionals about their ailments and must depend on adults to figure out their symptoms and report to the diagnostician (Epstein, 2019b).

On the other hand, differences in misdiagnosis rates between older children (above five years) and those below five do exist (Alexoaie *et al*., 2016). Alexoaie *et al*. (2016) explain that since health workers must rely on parents or immediate care takers/givers of children for information about their health, older children, especially those about to go into adolescent stage may withhold some fundamental information from their parents, which would have been essential in the diagnostic process. This may happen, especially for conditions related to drug use and sexual activity (Alexoaie *et al*., 2016). In this case, much more caution is needed in children compared with adults as regards misdiagnosis.

University of Ghana http://ugspace.ug.edu.gh

Different descriptions about misdiagnosis among adults have been given by various scholars (Zwaan *et al*., 2013c). Zwaan *et al*. (2013c) report that misdiagnosis is more likely to be observed in older patients (those aged sixty-five years and above) compared with young adult patients. The reason for this assertion is that older adults tend to have more comorbidities compared with the young adults that make it difficult to arrive at a diagnosis (Singh *et al*., 2014). Such comorbidities present with atypical signs and symptoms leading to high likelihood of misdiagnosis (Kotovicz *et al*., 2008; NAM, 2015b).

Besides, it is imagined that younger adults are more likely to engage themselves in the diagnostic decision making compared with much older adults and children, hence, likely to guide the clinician to make a better diagnostic decision (Brabers *et al*., 2017a). However, a study that evaluated clinical-pathological discrepancies among critically ill patients in three Brazilian hospitals reported that older patients were less likely to be misdiagnosed compared with younger patients since they died of conditions that had hitherto been diagnosed prior to admission (Fares *et al*., 2011),

Sex/gender differences and misdiagnosis

It has been suggested that there are gender disparities in the rate of patient misdiagnosis. When presenting with the same illness at an emergency centre for ailments like heart disease, the literature suggests that women are more likely than men to get the wrong diagnosis (NAM, 2015b; Newman-Toker *et al*., 2014). Several explanations have been advanced on this assertion (Turabian, 2017). Disease symptoms are usually manifested differently, more so being expressed from a psychosocial than biological perspective (Hof & Tarzian, 2001). Consequently, women tend

University of Ghana http://ugspace.ug.edu.gh

to be more sensitive to disease symptoms than men and this has sometimes made them be labelled as a sicker sex than men (Hof & Tarzian, 2001a; Turabian, 2017).

There are gender differences in the way pain due to certain illnesses is expressed among men and women (McGregor, 2019). A case in point is that sick women tend to over express the symptoms of their illnesses often attaching a great deal of emotional effects of the illness to their life (Hajjaj *et al*., 2010a). This gradually tends to distort the diagnosticians' reasoning, leading them to conclude that the main problem could be a mental health issue (Hajjaj *et al*., 2010a). Therefore, women are more likely to erroneously receive a psychotic diagnosis since they typically overstate their discomfort (Pieretti *et al*., 2016; Tunks *et al*., 1990).

Relatedly, health workers have responded differently to pain in both women and men. Men are more likely to be perceived as experiencing real pain, whereas women may be perceived as exaggerating their pain (Hof & Tarzian, 2001b). Men are therefore, more likely than women to receive analgesics for the same level of pain because their pain is viewed as real (Bartley & Fillingim, 2013). On the other hand, due to the similarities in how the symptoms for both disorders present, medical and gynecological conditions in women who come with abdominal discomfort frequently get mistaken for one another (Louis *et al*., 2016).

In the diagnostic process, communication between the patient and the diagnostician is crucial, particularly when patients take an active role by seeking clarification and by responding to those that are posed to them. However, Siu (2015a) explains that out of respect, women are less inclined

University of Ghana http://ugspace.ug.edu.gh

to question a diagnostic decision made by a male healthcare professional. This would make them more likely to receive a misdiagnosis.

However, some researchers disagree with the notion that women are more likely to receive wrong diagnoses, contending that for specific diseases, gender differences may increase the likelihood that persons who present similarly may be given the wrong diagnosis (Regitz-zagrosek, 2012a). In this sense, it is believed that since women are more likely than men to participate in the diagnostic decision-making process, they ultimately aid diagnosticians in making better diagnostic conclusions (Levinson *et al*., 2005). In addition, Gallant *et al*. (1997a) found that women were more likely than men to receive information about their illness that was significantly more technical in nature. This is a result of the tendency to inquire further about the diagnosis as soon as the diagnostician communicates it to them.

Conversely, it is thought that men tend to ask fewer questions and pay less attention to further explanations of the doctors' diagnostic decisions (Pieretti *et al*., 2016; The Health Foundation, 2013). As a result, this behaviour might make it impossible for the diagnostician to assess if the decision made was appropriate or not. However, this view differs from the earlier belief documented (Siu, 2015a). Additionally, it has been noted that because certain problems are assumed to affect women more frequently than men, males with certain illnesses, such as depression and osteoporosis, frequently obtain inaccurate diagnoses (Regitz-zagrosek, 2012a). The lack of definitive evidence regarding which gender is more prone to misdiagnosis emphasises the need for further research to confirm the truth, if any. The question of whether men or women are more prone to misdiagnosis remains unsettled. Therefore, additional academic research is needed to verify these assertions.

University of Ghana http://ugspace.ug.edu.gh

Patients' or caretakers' level of education and misdiagnosis

The patient's level of education is another factor believed to have an influence on misdiagnosis. Modest literature though exists explaining several accounts by which patients' educational level is associated with misdiagnosis (Goggins *et al*., 2014). The first account in this section explains the relationship between misdiagnosis and the education level of a patient if the history taking is obtained directly from the patient while the other account relates to the educational level when the history of the presenting illness is taken from another person in case of severely ill patient or for a minor.

The patient's educational level may influence diagnosis mainly in three ways (Wagner *et al*., 2019). In this regard, the level of education plays a central role in the diagnostic shared decision making between the patient and the diagnostician (Rademakers *et al*., 2012a). The understanding of the explanations given by the diagnostician as well as the ability of the patient to ask relevant questions regarding the decisions communicated by the diagnostician is very key in guiding the decision-making process (Brabers *et al*., 2017b).

Patients with a low level of education are understood to care less about the decisions made if compared with patients with higher education level (Goggins *et al*., 2014). Often, they tend to agree with whatever decision is made by their diagnostician as true (NAM, 2015). They also may have challenges in comprehending the information given by the diagnostician, hence, compelled to ask questions to gain a better understanding and clarify their uncertainties, as they seek to grasp the information communicated to them (Katz *et al*., 2007). They may as well have difficulties in explaining their medical problems, hence, failing to give appropriate responses to guide diagnostic decision making (Ip, 2010).

University of Ghana http://ugspace.ug.edu.gh

It is also likely that they may not ask the diagnostician questions, which possibly would be useful in guiding the diagnostic process (Rademakers *et al*., 2012). Unlike their counterparts with higher education who are more likely to ask probing questions to the diagnostician, patients with low level of education are more likely to ask questions that require the diagnostician to repeat the message already communicated (Katz *et al*., 2007). All these explain how difficult it may be for diagnosticians to arrive at a diagnosis, especially because of communication challenges with patients of low level of education, hence, a likelihood for them being misdiagnosed.

Closely associated with the above low level of education is the problem that may arise if patients, interpreters or caretakers/caregivers and the diagnostician can neither communicate easily in a local language nor with any of the other spoken international languages. A case in point is noted in a study in Canada where migrant patients, because of their inability to speak French, were more likely to be misdiagnosed (de Moissac & Bowen, 2019). In such a case, the diagnostician is left to make decisions with diminutive patient history to guide. On the other hand, some researchers pointed out that in some circumstances, low level of education by patients may lead to disagreements between patients and diagnosticians, especially when out of obliviousness or bias, patients disagree with a decision made culminating into a wrong diagnostic decision being made (Ba *et al*., 2014). In this circumstance, the diagnostic decision making becomes problematic as any diagnosis going against a patient's wish may not be accepted by the patient.

The impact of education level on misdiagnosis could also be explored in terms of health literacy or having a high or moderate level of education. Building on what was said in the paragraph before, it can be concluded that educated patients, concierges, or interpreters, especially those with a

University of Ghana http://ugspace.ug.edu.gh

higher level of education, are more likely than their counterparts with a lower level of education to be involved in the diagnostic decision-making (Ip, 2010). Additionally, they are more likely to understand what the diagnostician says and to clarify it with questions (Rademakers *et al*., 2012). Additionally, they are more likely than the uneducated to participate in the diagnostic decision-making (Brabers *et al*., 2017). Therefore, it is predicted that such patients would help the diagnostician to get a more accurate and well-informed diagnosis.

However, because educated patients often ask probing inquiries, this could lead to either a negative or positive outcome (Harun *et al*., 2017, Katz *et al*., 2007). A diagnostician would be given the chance to make a better decision by taking the time to comprehend the patient's point of view because of this (Harun *et al*., 2017). The negative effect is that because of the repeated probing inquiries by patients, diagnosticians may decide to cease considering other potential illnesses and concentrate on the patient's opinions to draw final findings (Katz *et al*., 2007). If the diagnostician fails to dispute the patient's incorrect opinions in the latter case, it could result in errors.

Social-cultural beliefs, racial, ethnicity and misdiagnosis

Clinical judgments can be influenced by sociocultural, racial, and ethnic biases, leading to potential misdiagnoses (Mamede *et al*., 2007). For instance, Black Americans are often incorrectly diagnosed with psychiatric conditions such as severe depression and schizophrenia (Good *et al*., 2005). This discrepancy is attributed to doctors' biases, which lead them to misdiagnose psychotic disorders in Black patients, even when the same symptoms are present in Euro-Whites or Latinos (Gara *et al*., 2019). Furthermore, cultural differences can affect how individuals express pain, symptoms, and emotions.

University of Ghana http://ugspace.ug.edu.gh

As a result, diagnosticians, influenced by their own cultural perspectives, may interpret the same symptoms differently in patients from diverse cultures (Hofmann & Hinton, 2014; O'Daniel & Rosenstein, 2008a). Language barriers between the patient and the diagnostician make communication difficult (O'Daniel & Rosenstein, 2008a). If the diagnostician cannot effectively communicate with the patient due to language issues, it is more probable that they will not have enough information to make a diagnosis (Ha *et al*., 2010). If a translation service is used, the problem could get worse, especially if the interpreter misinterprets the patient's symptoms (Laposata, 2018).

Patient's income status and misdiagnosis

The economic situation of the patient has been recognized as one of the elements that may result in patients receiving a misdiagnosis. This has been attributed to diagnosticians' prejudices when treating patients with varying socioeconomic levels (Arpey *et al*., 2017; Bernheim *et al*., 2008). In a study using simulated patients of low and high income, diagnosticians in Sudan obtained diagnoses faster when dealing with patients of low economic status than when dealing with patients of high economic status (Mohamed *et al*., 2016). Mohamed *et al*. (2016) found that diagnosticians tended to make more analytical diagnostic decisions when the patient's appearance indicated a good economic standing than when the patient appeared to be in poor health. However, further research is required to fully understand the relationship between misdiagnosis and a patient's economic or financial situation.

In other cases, patients without health insurance and those unable to pay for treatment, investigations, or screening tests are more likely to have incorrect diagnoses (Adler & Newman, 2002). Arpey *et al*. (2017) suggest that individuals who cannot pay for care may miss out on some crucial laboratory tests required for diagnosis. Without any laboratory or diagnostic tests,

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

diagnosticians are forced to make a diagnosis based only on the patient's clinical presentation (Beglinger *et al*., 2015). This increases the risk of misdiagnosis.

2.8.2 Disease related factors influencing misdiagnosis

The occurrence of misdiagnosis is credited partially to disease specific factors in some cases (NAM, 2015). Such disease specific factors that may increase the chance of occurrence of misdiagnosis include the severity of the disease, type of the illness, duration of the illness and familiarity of the diagnostician with the disease condition as explained thereafter.

Severity of the illness at admission time

Research has shown that in general care, critically ill patients are more likely to be misdiagnosed compared with less critically ill patients (Gillon & Radford, 2012). Fares *et al*. (2011b) established that only 30% of the critically ill patients had an absolute agreement between their initial diagnosis and postmortem findings in Brazil. Possible explanations given for such occurrences included, for example, the need to arrive at a diagnosis so that treatment could commence as soon as possible leads to early closure of the diagnostic process by the diagnostician without gathering sufficient information increasing the risk of misdiagnosis (Gillon & Radford, 2012; Lighthall & Vazquez-Guillamet, 2015). Additionally, the fact that in most cases, severely ill patients may at the same time be unconscious and cannot tell their story of the disease to the diagnostician, which in this case will have to be told by someone else, increases the chances of being misdiagnosed.

There are, however, other researchers who refute that critically ill patients receive false diagnoses often (Rendon *et al*., 2015). Rendon *et al*. (2015) assert that misdiagnosis is less likely to occur in

University of Ghana http://ugspace.ug.edu.gh

critically ill patients. This is because their atypical presentations are more likely to prompt diagnosticians to use analytical reasoning that involves slow cognitive processing. This may lead to arriving at the correct diagnosis more appropriately. However, this contradicts the earlier assertion that the diagnostic decision-making process in critically ill patients is always expedited in the quest to arrive at a diagnosis such that treatment commences as soon as possible (Gillon & Radford, 2012; Lighthall & Vazquez-Guillamet, 2015). As a result, it is recommended that all patients admitted in a critical condition receive a second diagnostic opinion from an expert diagnostician (Singh *et al*., 2013). This is to rule out diagnostic errors.

Type of illness and misdiagnosis

Literature has uncovered varying occurrences of misdiagnosis for various conditions (Laposata, 2018; Singh *et al*., 2013). For example, it has been established that misdiagnosis is common for heart related diseases such as coronary heart disease, circulatory disorders (Gibson *et al*., 2017; Graber, 2013). There are several reasons for this, one of which is that diagnosticians are often more proficient in diagnosing infections than other diseases (Fares *et al*., 2011). Additionally, diagnosing cardiovascular and other non-infectious diseases can be challenging, a difficulty that may be amplified if the patient is critically ill and has other concurrent health conditions (Fares *et al*., 2011). Fares *et al*. (2011) compared misdiagnosis among cardiovascular diseases and infections and found that making a wrong diagnosis was four times higher in patients with cardiovascular diseases than it was for infections in Brazil.

Various reasons were given for this, including the prospect that diagnosticians have been well trained to diagnose infections compared with other diseases as well as the challenge that exist in

University of Ghana http://ugspace.ug.edu.gh

diagnosing cardiovascular and other non-infectious diseases, which may be exacerbated if the patient is critically ill with other comorbidities (Fares *et al*., 2011). Misdiagnosis has also been common with cancer and tumors as other studies have demonstrated that misdiagnosis could also occur with infections such as meningitis, pneumonia, and appendicitis (Laposata, 2018; Singh *et al*., 2013). Thus, it can be deduced that misdiagnosis could much more occur with certain disease conditions than others though this may depend on the morbidity profile of a particular healthcare system.

Duration of the illness and misdiagnosis

The likelihood of a misdiagnosis varies based on how long a patient has had their condition. Diseases are classified as acute (lasting less than two weeks) or chronic (lasting more than two weeks) (Starfield, 2011). Leske *et al*. (2018) noted that diagnostic errors in a university hospital in the USA were more prevalent in institutions dealing with chronic disorders (60%) than those handling acute conditions (34%). A possible explanation put forth to clarify the situation was that individuals with chronic illnesses who had received long-term care were knowledgeable of these conditions and, as a result, took an active part in diagnostic procedures (Graber *et al*., 2017b). They were therefore, more likely to influence the clinician to treat the disease or condition they knew.

In doing so, a clinician who is unaware of this risk may misdiagnose the patient by failing to consider anything beyond what the patient leads them to believe, which is known as preference misdiagnosis (Sathanapally & Khunti, 2018). Additionally, Murrow and Oglesby (1996) note that acute conditions are frequently linked to a particular body area. This makes it simpler to recognize and treat acute conditions than chronic ones, which affect multiple body systems and are therefore, challenging to diagnose and treat.

University of Ghana http://ugspace.ug.edu.gh

Familiarity of the diagnostician with the disease condition and misdiagnosis

Misdiagnosis is also thought to occur depending on how familiar the diagnostician is with a patient (Berenson *et al*., 2014). Berenson *et al.* (2014) argue that when clinicians are used to seeing patients with certain illnesses, they get persuaded to assign most patients presenting with similar signs and symptoms with the same disease diagnosis. These analysts explained that it was therefore, not surprising that when a disease condition was uncommon, it was more likely to be misdiagnosed the time it manifested/presented in a patient.

During the diagnostic decision-making process, even when encountering difficulties, medical professionals tend to choose a diagnosis that is easier to manage and shares similar symptoms with the complex disease in question (Berenson *et al*., 2014). Besides, when a disease is rare, it is less likely that the diagnosticians will have the required experience to diagnose such an illness (WHO, 2016). Familiarity with a disease may lead to over confidence culminating into unintentional bias, which eventually may lead to misdiagnosis (Berner & Graber, 2008). This may explain why patients, especially children with fevers in most malaria endemic countries are diagnosed with malaria (WHO, 2016).

Comorbidity and multi-morbidity as facilitators to misdiagnosis

Comorbidity and multimorbidity have been linked to diagnostic error (Meghani *et al*., 2013). Comorbidity is defined as the presence of another disease(s), condition(s), or illness(es) in a patient prior to the primary disease or condition, where the primary disease or condition is one for which the patient is receiving treatment or care (Valderas *et al*., 2009). The risk of misdiagnosis increases with increased comorbidity at the time of the patient's presentation for admission (Winters *et al*., 2012a). This is primarily because the presence of comorbidities complicates the diagnostic

University of Ghana http://ugspace.ug.edu.gh

process, causing a delay in reaching the correct diagnosis (Meghani *et al*., 2013; Mounce *et al*., 2017).

When a patient is admitted and treated for multiple diseases or conditions at the same time, it can lead to a higher risk of misdiagnosis. Multi-morbidity puts additional pressure on the medical professional to make an accurate diagnosis (Navickas *et al*., 2016a; Panagioti *et al*., 2015). Hausmann *et al*. (2019) explain that medical professionals often encounter challenges when diagnosing patients with multiple health issues. The complexity of these cases may necessitate the involvement of a specialist, especially when the health conditions are not related. Despite this, the fact remains that in most outpatient departments, it's the general practitioners who are primarily responsible for diagnosis. However, they might not always possess the comprehensive expertise needed to accurately diagnose these complex conditions (Foot *et al*., 2010).

2.8.3 Health system factors contributing to misdiagnosis

The complexity of the health-care system has been identified as one of several factors that may contribute to misdiagnosis. These health system factors span the six building blocks of the health system, including factors related to service delivery, leadership and governance, human resources for health, technologies and tools used in patient diagnosis, health information and communication, and health service financing (Neshati *et al*., 2018; Ojurongbe *et al*., 2013; Petti *et al*., 2006). Some of the factors discussed in relation to the broad themes of the health system building blocks are the referral systems, supervision of care, record keeping, and the existing safety culture, team process of laboratory and other investigations, and communication systems.

University of Ghana http://ugspace.ug.edu.gh

2.8.3.1. Services delivery

This building blocks of a health system include all the processes involved in providing health care. These include patient interactions with healthcare providers, such as referral systems, history taking, laboratory and radiological investigations, and all other activities related to diagnostic decision making (Rabie *et al*., 2017).

Laboratory and radiological tests

Laboratory and radiological tests and investigation, when well conducted are usually utilised in the diagnostic process to confirm or rule out medical conditions based on the presenting signs and symptoms (Armstrong & Hilton, 2014; Epner *et al*., 2013a). In many health facilities in Africa, laboratory facilities are absent and where they are, the testing and investigative capacity is limited such that most diagnosis is clinically made based on signs and symptoms (Wilson *et al*., 2018). The reliance on clinical diagnosis based on symptoms and signs has been found to be non-specific, less reliable and a common cause of diagnostic error, especially for infectious disease conditions such as malaria and Tuberculosis (Neshati *et al*., 2018; Ojurongbe *et al*., 2013; Petti *et al*., 2006). However, this requires diagnosticians to be conversant with laboratory findings and all laboratory reference points, something, which is always not possible among all clinicians and physicians (Carter et al., 2005).

Despite the relevance of laboratory tests and other investigations in the diagnostic process, errors are often committed in either laboratory or radiological investigations either before (pre-analytical), during (examination) and after (post-analytical) phase (Epner *et al*., 2013a; Nandini, 2016; Petti *et al*., 2006; Plebani, 2006). These errors have been blamed on various factors such as

University of Ghana http://ugspace.ug.edu.gh

limited sensitivity and specificity of some tests, incomplete laboratory or other investigative tests information requisition, while in others, problems in test ordering that may come in way of poor ordering of tests, delay in ordering tests, may lead to errors in testing (Dogether *et al*., 2016; Neshati *et al*., 2018). Other laboratory errors due to pre-examination may be due to poor entry of laboratory orders, mix-up of patients' forms, poor specimens' collection and transportation methods, and errors in samples' labelling (Nandini, 2016).

Some errors may occur during the examination phase such as failure to follow laid out procedures, errors due to faulty or malfunctioning equipment and mix-up of samples (Lee, 2017). Errors occurring post laboratory examination may be due to poor reporting of results, no reporting at all and poor interpretation of test results (Laposata, 2014; Nandini, 2016). Laboratory supplies such as test kits and reagents are crucial in making investigations whose results become important for making appropriate diagnostic decisions. The stock-outs of some of these supplies may lead to failure to conduct tests or the use of expired supplies or faulty which may contribute to the use of damaged or expired test kits, incorrect test kits, and buffer (Johnson *et al*., 2017). An incorrect diagnosis may also result from uncalibrated or unintentionally poorly calibrated laboratory apparatus leading to faulty test results that lead to the wrong diagnostic decision (Berner, 2017). All these explanations indicate that while reliance on investigations and tests has been common in the diagnostic processes, in some circumstances, the results from these investigations may lead to error. The extent and mechanisms to which this occurs remain unknown in many healthcare settings. In this case, avoidance of diagnostic areas requires clinicians to triangulate findings of laboratory and/or radiological tests with signs and symptoms.

University of Ghana http://ugspace.ug.edu.gh

Referral system and misdiagnosis

Patient referral describes the transfer of a patient by one practitioner to another (usually from a lower primary healthcare facility to a higher facility) for specialized care or when a referring practitioner is unable to manage the patient (Foot *et al*., 2010). Common components of good referral notes should include reasons for referral, diagnosis, clinical signs and symptoms, examination or test results done, medical history, including urgency for treatment, current and past medication (Berta *et al*., 2008; Foot *et al*., 2010).

Misdiagnosis has been common among patients referred from other primary centres. Kaisey *et al*. (2019) studied misdiagnosis among 241 patients referred with a diagnosis of multiple sclerosis to two academic centres in Los Angeles and established that 18% of these patients were misdiagnosed. A study among pediatrics patients in a third level hospital revealed that incorrect diagnosis was more common among paediatric patients with surgical conditions referred from lower-level hospitals in Mexico (Bracho-Blanchet *et al*., 2014).

Sometimes, patients are referred without referral notes, making it hard for the receiving physicians to manage the patient (Neshati *et al*., 2018). Neshati *et al*. (2018) informed that in other situations, the referred patient may have the referral notes, but may have been poorly managed or wrongly diagnosed by the referring clinician. This becomes problematic leading to misdiagnosis of such a patient should the receiving clinician or physician rely on such notes (Bracho-Blanchet *et al*., 2014). There are times when clinicians who receive referred patients admit such patients at the receiving health facility based on the provisional or referring diagnosis without taking an initiative of reformulating the diagnosis (Lighthall & Vazquez-Guillamet, 2015).

University of Ghana http://ugspace.ug.edu.gh

It is believed that expertise of the referring professional has a great influence on the quality of referral. Consultant paediatricians, for example, made better and reliable referral notes compared with general practitioners, which make it easier for the receiving provider to make a proper diagnosis (Lighthall & Vazquez-Guillamet, 2015). In other circumstances, the referring clinician(s) write notes that are either not read or overlooked by the receiving (admitting) physician, yet such notes would have been much useful to the admitting clinician to help arrive at diagnosis (Neale *et al*., 2011). Receiving physicians may also ignore notes of referring clinicians if deemed to be of poor quality to be relied on (Davis *et al*., 2017). All these confirm the likelihood of patients who are referred from other centres being misdiagnosed because of referral related challenges.

2.8.3.2 Governance and leadership and its influence on misdiagnosis

Quality healthcare requires that good leadership and governance exists that will design rules, set systems, come up with policies and institute systems that ensure that hospitals deliver the desired quality of care to their users (World Health Organization, 2018). When these are put in place, this will help in averting poor quality healthcare misdiagnosis inclusive. Among the key aspects that may ensure quality diagnosis include putting in place a safety culture that emphasises quality diagnosis and mechanisms for ensuring supervision of care being delivered with timely feedback provided to the health workers for stimulating improvement.

Hospital safety culture

Having a patient safety culture in healthcare is crucial to improving diagnostic accuracy and care quality (Clinical Excellence Commission, 2015). It is important to avoid blaming those involved in an error, and to openly discuss incidents to identify and learn from diagnostic errors (Graber,

University of Ghana http://ugspace.ug.edu.gh

2015). It is also critical to provide diagnosticians with feedback on their diagnostic performance. It is also critical to anticipate diagnostic uncertainty and follow guidelines to reduce misdiagnosis.

In healthcare settings with a strong patient safety culture, there is an opportunity to minimize misdiagnoses (Alam *et al*., 2017). Misdiagnosis issues are likely to reoccur without a learning culture. Diagnosis requires effective relationships between diagnosticians and their peers (NAM, 2015). As highlighted, the open review of error root causes by diagnosticians, managers, and other health workers demonstrates a safety culture (Newman-Toker *et al*., 2017). When these practices are combined, they form a safety culture that helps healthcare facilities prevent misdiagnosis.

Misdiagnosis due to organization of care during time of the day and course of the week

Certain environments are more prone to errors than others, such as the location and time of day of the diagnosis. Patients are admitted via emergency rooms or outpatient departments, which are thought to be "factories" for diagnostic errors (Graber, 2013). Consequently, emergency departments have been designated as natural laboratories for studying diagnostic errors and gathering information about misdiagnosed patients. This includes those who have previously been misdiagnosed and returned for treatment within two weeks (NAM, 2015). The subsections that follow offer more details on how these environments contribute to diagnostic errors.

Admission day and misdiagnosis

A patient's admission day has been identified as a risk factor for misdiagnosis (Clinical Excellence Commission, 2015). When compared to weekdays, the weekend has been linked to higher rates of diagnostic errors, resulting in a phenomenon known as "the weekend effect" (Hoshijima *et al*., 2017; Mathew *et al*., 2018; Zwaan *et al*., 2016). Furthermore, it has been reported that the risk of

University of Ghana http://ugspace.ug.edu.gh

death for weekend admissions was 12% in the United States, higher than for weekday admissions (Benavidez *et al*., 2014). Mathew *et al*. (2018) provided several explanations, including staff shortages and declining access to services for this occurrence of events.

Accordingly, diagnosticians may not be able to receive advice from senior colleagues leading to challenges in making suitable diagnostic decisions. As a result, high patient mortality rates for patients in Japan were observed over the weekend due to failure to have specialist consultations and investigations to establish appropriate diagnosis to lead to proper care (Hoshijima *et al*., 2017). Furthermore, a two-month study in primary care conducted in the United Kingdom reports that many patients' diagnoses were not being supported by investigations over the weekend due to skipped laboratory tests (Balla *et al*., 2012).

Overcrowding is another challenge that causes diagnostician fatigue, which increases error risk. This happens most on some weekdays at emergency rooms particularly at the start of the week (Clinical Excellence Commission, 2015). A study in Ethiopia reported that overcrowding in emergency rooms resulted in rushed assessments, delayed diagnoses, and insufficient attention to detail resulting in misdiagnoses (Negasi *et al*., 2022). Furthermore, Derlet *et al*., (2014) emphasise that overcrowding results in reliance on junior staff, breakdowns in communication, limited access to diagnostic resources, staff fatigue, overloading of patients, insufficient documentation, and increased stress. These explanations demonstrate how various factors can contribute to misdiagnosis on various weekdays.

University of Ghana http://ugspace.ug.edu.gh

Time of the day at admission (duty shift at admission) and misdiagnosis

The time of day a patient is seen by a diagnostician has previously been identified as a risk factor for misdiagnoses. Night shift, for example, has been identified as the shift where diagnostic errors occur (Benavidez *et al*., 2014). A systematic review on the frequency of misdiagnoses in the Intensive Care Unit (ICU) discovered a correlation between the time of hospitalization and the risk of misdiagnoses in the ICU, specifically during evening and night hours (Winters *et al*., 2015). Night shifts are associated with increased stress among diagnosticians, increasing the likelihood of misdiagnosis (Hughes, 2015).

Furthermore, tiredness and fatigue are more evident at night, reducing diagnosticians' speed and cognitive ability (Zwaan *et al*., 2016). Jha et al., (2001) observe that physicians who work at night have a disrupted sleep pattern, which can aggravate fatigue and impair diagnostician cognitive capacity. This further reduces the diagnostician's effectiveness. Furthermore, diagnosticians are more likely to violate policies, guidelines, and procedures overnight, for example, by conducting fewer clinical assessments of patients (Lazzari *et al*., 2018). All of these explain why misdiagnosis is generally more common at night.

2.8.3.3 Health information, communication, technology and misdiagnosis

Health information, communication, and technology are components of a health system that includes information gathering, information organization, and diagnosis decision-making systems (El-Kareh *et al*., 2013). Failures in any of these building blocks could result in diagnostic errors. Improved communication and health information technology can reduce diagnostic errors (Alotaibi & Federico, 2017).

University of Ghana http://ugspace.ug.edu.gh

Records keeping and misdiagnosis

Medical records are critical for patient care and administration. The availability of numerous medical records prepared by different hospital departments facilitates diagnosis and treatment processes (Chiwanza & Mutongi, 2017; Chowdhury & Habib, 2015). Current and past patient histories, examinations, tests, and other investigations, and current and past medical treatments are all documented in records critical to diagnostic decision-making (Spooner & Pesaturo, 2013a). However, some explanations for medical records-associated misdiagnosis include patients not presenting their previous medical records on a return visit to the hospital, which is common practice with paper-based medical records (Chowdhury & Habib, 2015). In other cases, documentation issues such as illegible or incomplete records may discourage diagnosticians from using or consulting available patient records when making diagnostic decisions (Clinical Excellence Commission, 2015).

A study in South Africa reported that if patients had prior contact with healthcare systems and had challenges related to medical records, this could lead to diagnosticians making decisions based on incomplete or unreliable information (Marutha & Ngoepe, 2017). Occasionally, because of the patient having had many encounters with healthcare providers, numerous files may be held by one patient. This complicates the retrieval of the patient's information from such files (Spooner & Pesaturo, 2013). Such files may also, easily get lost or be forgotten by patients at home prior to hospital visit, hence, denying diagnosticians vital information that would be helpful in the diagnostic process (Marutha & Ngoepe, 2017). The absence of appropriate medical records can certainly result in misdiagnosis or inappropriate treatment leading to serious consequences to patients.

University of Ghana http://ugspace.ug.edu.gh

Many of the problems mentioned above have been associated with the use of paper-based records. Consequently, the recent, introduction of Electronic Medical or Health Records (EMR/EHR) had been viewed as one of the interventions anticipated to resolve the above challenges (Mehta & Pandit, 2018). Nevertheless, the EHRs have also at times been associated with diagnostic errors. These errors emanate mainly from the practice of copy and paste without authenticating the information being transferred. This leads to wrong patients' information being exchanged which when used for decision making may lead to wrong decisions (Berenson *et al*., 2014; Graber *et al*., 2019). Similarly, electronic medical records are at times associated with challenges of mislabeling, miscoding and misclassification, which in one way or another may be linked to the occurrence of misdiagnosis (Newman-Toker, 2014).

Miscoding refers to the assigning of a wrong or vague diagnosis codes (de Lusignan *et al*., 2012). Miscoding has been associated with coder-related error where wrong codes are assigned due to wrong data abstraction from the records or rather than assigning the specific code for a condition, a generic code is assigned instead (known as a mis-specification error) (Daniel *et al*., 2017). Miscoding or unspecified laterality (incorrect labelling of a condition based on the side of the body affected i.e., right versus left side of the body) is associated with having limited understanding of the diagnostic codes (Southern *et al*., 2016b). An example of misdiagnosis due to misclassification is reported in a study where a patient with type 2 diabetes received a code of type 1 diabetes in London (de Lusignan *et al*., 2012). It has also been observed that if diagnosticians rely on records of hitherto misdiagnosed conditions, this may contribute to patients' misdiagnosis (de Lusignan *et al*., 2012). This, thus, necessitates diagnosticians to use previous medical records with caution when diagnosing patients since the conditions in the records may have been misdiagnosed.

University of Ghana http://ugspace.ug.edu.gh

Communication and coordination of care

The coordination of care is very crucial for a successful diagnostic process. Coordinated care is healthcare that involves the interactions and communication between the patient and families with the various healthcare providers, which is crucial in the diagnostic processes (O'Daniel & Rosenstein, 2008b; Singh *et al*., 2017b). Such personnel include nurses, consultants, clinicians, physicians, radiologists, pathologists, clinical laboratory personnel and other professionals who may be consulted when needed to arrive at a diagnosis (Clinical Excellence Commission, 2015; NAM, 2015b). Uncoordinated and disjointed care coupled with poor communication have been blamed for diagnostic error in various circumstances (Mcdonald *et al*., 2013). Uncoordinated care manifests in the form of; failure to share and discuss laboratory results, failure to share information among various providers, and failure to consult some providers like nurses, pathologists, psychologists, radiologists (NAM, 2015b; Schiff, 2009).

2.8.3.4 Human resources for health factors and misdiagnosis

There are health workers (otherwise, referred to as health human resources) related factors that may predispose a patient to being misdiagnosed. Such factors include the diagnostician's gender, experience, competencies, right numbers, requisite qualifications and age.

Competencies of the health workers and misdiagnosis

To make accurate diagnoses, diagnosticians must possess a certain level of clinical reasoning skills (NAM, 2015). Generally, their diagnostic competency is assessed using two methods of reasoning. The first is fast-thinking, also known as heuristic or non-hypothetical thinking (also known as system thinking 1) (Berner, 2017). The other type of reasoning employed in the diagnostic

University of Ghana http://ugspace.ug.edu.gh

procedure is System Thinking 2, which is hypothetically based or analytical thinking (NAM, 2015).

Fast-thinking diagnostic reasoning, also known as non-analytical thinking, is frequently triggered by memories or familiarity with a disease (Norman *et al*., 2017). Diagnosticians use this approach to arrive at a diagnosis quickly because of the ability to identify similarities between the symptoms and signs exhibited by a patient and what they have seen in the past (NAM, 2015). Even though this approach is credited with shortening diagnosis times, it can easily lead to incorrect diagnoses when dealing with atypical cases (Berner, 2017; Norman *et al*., 2017).

System thinking 2, also known as analytical, slow, or hypothetical-deductive thinking, is a diagnostic process that entails gathering relevant patient history, testing assumptions, and employing critical thinking skills (Graber *et al*., 2012). It entails using critical thinking skills and inferential reasoning to question decisions made and consider possible alternatives (Berner, 2017). It may likely be applied by junior practitioners (non-experts) and when diagnosing unfamiliar conditions (NAM, 2015). While this method has been praised for its ability to reduce diagnostic error, it has also been criticised for being time consuming.

There has been much debate about Ugandan health workers' diagnostic abilities. Several studies have found gaps in their competency when it comes to diagnosing and treating certain illnesses (Katende *et al*., 2015; Nantanda et *al.,* 2020). For example, Nantanda et *al.* (2020) discovered that more than half of the health workers surveyed admitted to having difficulty managing disorders such as Asthma and Chronic Obstructive Pulmonary Disease (COPD). Katende *et al*. (2015) raised

University of Ghana http://ugspace.ug.edu.gh

additional concerns about clinicians' and nurses' competency in the diagnosis and treatment of chronic diseases reported competency gaps among clinicians and nurses in diagnosing and managing chronic diseases.

Experience of the diagnostician and misdiagnosis

It has long been assumed that diagnosticians with more experience make better diagnostic decisions, as they have had more time to hone their skills due to their knowledge and astuteness (Shanteau, 2015; WHO, 2016; NAM, 2015). It is also believed that experienced diagnosticians are more likely to quickly spot patients' issues and arrive at a correct diagnosis based on a few signs and symptoms as well as draw on past experiences and cues (Kostopoulou *et al*., 2008; Wiggins & Loveday, 2015).

Some authors, however, argue that clinical experience does not always lead to correct diagnoses (Shanteau, 2015). Shanteau (2015) demonstrated that even two experts can arrive at different diagnoses for the same patient, implying misdiagnosis. Kostopoulou *et al*. (2015) found no difference in accuracy between novice and experienced physicians. Some have even identified the diagnostician's experience as a possible source of biased decisions, due to reliance on shortcuts or past familiar symptoms (NAM, 2015).

When evaluating patients, experienced clinicians also tend to use non-analytical reasoning rather than systematic and thoughtful reasoning (Mamede et al., 2007; Van den Berge, 2012). This non-analytical approach may result in bias or misdiagnosis due to an 'anchoring effect,' in which an expert becomes fixated on the initial diagnosis despite having access to the latest evidence (Berner

University of Ghana http://ugspace.ug.edu.gh

& Graber, 2008; NAM, 2015a; Van Den Berge & Mamede, 2013). Inexperienced physicians, on the other hand, are not immune to analytical decision-making errors.

Health workers' qualifications and misdiagnosis

Medical professionals' qualifications have a significant impact on their diagnostic knowledge and skills (Braun *et al*., 2017). Various health systems have trained mid-level professionals to provide primary and secondary health care services in accordance with a country's planning due to a shortage of medical officers (Cawley & Hooker, 2018; Halter *et al*., 2018; Maier *et al*., 2018). These healthcare workers in Sub-Saharan African countries are known as physician assistants, medical/physician assistants, assistant medical officers, clinical associates, or clinical officers (Couper *et al*., 2018). In some healthcare systems, nurses are assigned diagnostic tasks normally performed by other cadres (Maier *et al*., 2018).

Clinical officers, for example, typically work in outpatient primary care settings. In Kenya, Nigeria, South Africa, and Uganda, clinical officers serve as diagnosticians, determining which patients should be hospitalised and which should receive outpatient care (Couper *et al*., 2018; Katende *et al*., 2015). Other health professionals involved in the diagnostic process, such as psychiatric clinical officers, ophthalmologists, anesthesiologists, nutritionists, and reproductive health specialists, receive specialised training in their fields to provide secondary health care (Wemos and ACHEST, 2019). They are consulted as specialists on cases related to their specializations.

However, there are arguments over whether diagnosticians' qualifications (undergraduate versus graduate education, as well as undergraduate versus postgraduate education) have an impact on

University of Ghana http://ugspace.ug.edu.gh

their errors (Das *et al*., 2018; Drennan *et al*., 2015; Halter *et al*., 2013; Hooker & Everett, 2012). Non-graduate doctors, also identified as "informal diagnosticians," are often faulted for misdiagnoses and other errors in some healthcare systems because it is thought that they lack the necessary training to make a precise diagnosis (Drennan *et al*., 2015; World Health Organization, 2016). Because they have received the necessary training, more qualified diagnosticians are thought to perform better patient examinations or better history taking. As a result, it is believed that increasing the number of non-graduate diagnosticians in a particular healthcare system will increase the number of misdiagnoses (Drennan *et al*., 2015).

However, some scholars dispute this claim. For instance, Das *et al*. (2015) note that better clinical practice is not always the result of better medical knowledge. Furthermore, Das *et al*. (2018) disputed the notion that more advanced skills are directly related to better diagnostic decisions. The same researchers emphasise the need for effort and skill when applying knowledge to practice. Other systemic and environmental factors, such as those already mentioned, may also impact the distinction between certified and non-certified diagnosticians (Hooker & Everett, 2012).

Additionally, different healthcare systems function differently, with some undergraduate diagnosticians outperforming their postgraduate counterparts in making precise diagnoses (Halter *et al*., 2018). While medical officers were thought to be better at diagnosing than nurses or clinical officers, a study found that graduate diagnosticians in India, were only 9% more accurate than non-graduate physicians (Das *et al*., 2015). Furthermore, Das *et al*. (2018) found that 20–50% of nurses in Kenya, had higher accuracy than medical officers by 25%. This indicates that advances in graduate diagnosticians do not always translate into better clinical practices.

University of Ghana http://ugspace.ug.edu.gh

One potential strategy to enhance diagnostic results and address some of the individual weaknesses mentioned above is the use of collaborative decision-making (NAM, 2015). To make the best decision for the patient, two or more health workers combine their knowledge and expertise (Cawley & Hooker, 2018). Participation in this process may be required of health professionals from the same or different disciplines. Hackmann *et al*. (2019) suggest that in other situations, it might be necessary to involve the patient in a collaborative diagnostic decision-making process.

Teamwork, consultation and misdiagnosis

Due to the complexity of health, health workers from different backgrounds must work together during the diagnostic process if effective results are to be achieved (NAM, 2015). Effective communication and the appropriate use of experienced and well-trained staff are essential elements of good teamwork (Angel *et al*., 2017; Dingley *et al*., 2008). The lack of collaboration in consulting rooms has resulted in a high misdiagnosis rate (Traber *et al*., 2013).

It has been suggested that collective intelligence could increase collaboration and diagnostic efficiency (Kurvers *et al*., 2016). Studies have shown that collective intelligence can increase diagnostic accuracy by up to 85.6%, compared to 65% at the individual level, even in groups, including both experienced physicians and students (Barnett *et al*., 2019; Fihn, 2019; Kurvers *et al*., 2016; Radcliffe *et al*., 2019). Collective intelligence focuses on the advantages a group has over an individual in terms of group strengths such as experience, skills, education, and communication (Hernández-Chana *et al*., 2016). These teams can be made up of physicians, nurses, laboratory personnel, radiologists, tutors, students, and other related health workers, depending on the specific circumstances of each case (Hernández-Chana *et al*., 2016; Radcliffe *et*

University of Ghana http://ugspace.ug.edu.gh

al., 2019). Additionally, this strategy allows inexperienced diagnosticians to learn from more skilled peers instead of relying solely on themselves (Fihn, 2019).

Nurses' persistent exclusion from the diagnostic process by physicians is another element associated with misdiagnosis (NAM, 2015). Given their reputation for coordinating care between diagnosticians and closely monitoring patient care, nurses are in an ideal position to know more about a patient's disease than anyone else (Clinical Excellence Commission, 2015; NAM, 2015). However, communication between medical staff working in different departments or clinics, while crucial, is often overlooked, which can lead to further misdiagnosis (Schottenfeld *et al*., 2016).

The ratio of patients to health workers

Patient safety and quality of service are influenced by the number of patients per healthcare provider (Sharma & Rani, 2020). For a country to achieve universal health coverage, doctor-to-population and nurse-to-population ratios show the number of patients each would need to care for (Spath & DeVane, 2009). The World Health Organization recommends a doctor-patient ratio of 10:10,000 to ensure high-quality care. While there is no standard nurse-to-resident ratio, 23 nurses per 10,000 people are thought to be insufficient to provide high-quality health care (Saralegui-Gainza *et al*., 2021). However, national standards and the workload of a particular healthcare facility or department should be considered when determining the recommended caregiver-patient ratio (WHO, 2016b).

Uganda has made progress in training human resources for health care, but the estimated doctor-to-patient ratio for 2020 was 1.7/10,000 and the nurse-to-midwife ratio was 12.4/10,000, both

University of Ghana http://ugspace.ug.edu.gh

below WHO recommendations (Ajari & Ojilong, 2020; Wemos and ACHEST, 2019). In Ugandan hospitals, clinicians play a vital role in diagnosis, but there is no set standard; estimates from 2019 assume 1:10,000 (Wemos and ACHEST, 2019, 2019). Although Uganda's population doubled from 21 million in 2000 to 44 million in 2022, district hospital staffing standards remain unchanged from 2000 at five doctors per general hospital (Wemos and ACHEST, 2019).

Most positions have been filled, but the overall health worker population ratio remains low. For example, a Mityana hospital audit reported nine clinical officers existed out of the six required by government staffing standards translating to 150% staffing level (Ministry of Health, 2015b). However, a WISN study suggested that 40 clinical officers were needed for fiscal year 2013/2014, but only four were present - resulting in high workload that impacts care quality (Govule *et al*., 2015).

Inadequate human resources cause problems with healthcare quality and patient safety. Due to workload stress, there is likely shorter consultation time, leading to misguided decisions. Standard consultation time is 15 minutes, but on average nine minutes are spent with each patient. Poor history taking makes it difficult for diagnosticians to properly review patients, which makes outpatient and emergency departments, especially vulnerable to misdiagnosis. The National Academy of Medicine confirms inadequate history taking as a contributing factor here as well (NAM, 2015). Staff shortages add pressure from fatigue from long hours leading to poor patient relations, hence, impacting cognitive potential and performance leading to misdiagnosis possibilities too (Ghooi & Deshpande, 2012; Kabatooro *et al*., 2016; Sandikci *et al*., 2017; Weiss *et al*., 2016).

University of Ghana http://ugspace.ug.edu.gh

Diagnostician gender and misdiagnosis

While the literature is not conclusive on who has a higher likelihood of misdiagnosing patients, several studies suggest that female diagnosticians have better diagnostic processes than their male counterparts (Hajjaj *et al*., 2010b; Orton & Pereira-Gray, 2016; Tsugawa *et al*., 2017). It has been shown that female physicians tend to practice evidence-based medicine, order investigations to guide diagnostic decisions, and communicate more effectively with patients, building trust and providing valuable information (Hajjaj *et al*., 2010). Tsugawa *et al*. (2017) also noted that they meticulously follow practice guidelines and have longer consultation times for patients.

Additionally, female physicians tend to spend more time during patient consultations than their male counterparts (Orton & Pereira Gray, 2016). Orton and Pereira Gray (2016) also highlight that these interactions are not only longer, but also perceived as more focused on the patient's needs. Rhoades *et al*. (2001) support this assertion, noting that female diagnosticians tend to allow patients to explain their conditions with minimal interruptions. Based on this evidence, female diagnosticians make better diagnostic decisions. However, because no empirical studies have shown who among male and female diagnosticians makes more mistakes, this presents a compelling reason for further investigation.

Age of the diagnostician and misdiagnosis

Some studies have suggested that the diagnostician's age may be related to misdiagnosis. This relationship is closely related to the diagnostician's experience (Mamede *et al*., 2007b). Although this is not always the case, experienced diagnosticians are generally, expected to be older than their novice counterparts (Ericsson, 2008). Despite their inexperience, some health workers may gain expertise in a specific task at a young age. Alternatively, health workers may have entered the

University of Ghana http://ugspace.ug.edu.gh

medical field later, making them older physicians in age, but novices in practice. Diagnosticians' clinical experience is linked to their age or length of practice. Elderly doctors are thought to be more prone to premature closure and rely on non-analytical reasoning during diagnostic decision-making (Berner & Graber, 2008; Mamede *et al*., 2007b; NAM, 2015b). However, a study discovered that health providers aged 50 and older were less likely to make diagnostic errors than their younger counterparts (Mamede *et al*., 2007). Mamede *et al*. (2007) explain that this was attributed to the older providers' higher level of experience, which increases the likelihood of them making better diagnostic decisions.

Supervision of care and prevention of misdiagnosis

Appropriate supervision of healthcare workers is essential to improving healthcare delivery quality. Similarly, proper support and supervision of personnel in charge of making diagnostic decisions are required to prevent diagnostic errors (Clinical Excellence Commission, 2015; Nguyen *et al*., 2017). Supervision is particularly, critical for junior clinicians and trainees to prevent diagnostic errors (NAM, 2015). For example, during supervision, a senior staff member can offer technical assistance or advice on investigations and their interpretation if a junior staff member encounters diagnostic challenges (Clinical Excellence Commission, 2015). However, contemporary literature lacks information on how hospitals emphasise supervision for better diagnostic decision-making. This highlights the need for further research to establish how supervision, or the lack thereof, contributes to misdiagnosis. Although this study did not specifically explore referral quantitatively, such variables not targeted under the quantitative part of this study were qualitatively explored.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

2.8.3.5 Medical diagnostic devices, equipment, supplies and misdiagnosis

Clinicians rely on various medical diagnostic equipment and supplies, such as stethoscopes, sphygmomanometers, thermometers, ophthalmoscopes, otoscopes, and electrocardiographs, to aid in making diagnostic decisions (Carter *et al*., 2005a). Additionally, there are specific devices and rapid diagnostic tests for certain diseases that require highly skilled personnel or specialists to operate. However, misdiagnosis can occur due to several factors related to the diagnostic equipment. For example, clinicians may lack access to examination devices, or the devices may be faulty or not well calibrated, which can lead to misdiagnosis (World Health Organization, 2021b). In other cases, the reagents required for certain devices may not be available, rendering the device unusable.

Moreover, clinicians may not be familiar with how to operate certain devices, particularly newer or unfamiliar technologies, resulting in misdiagnosis, particularly among younger and less experienced clinicians (Armstrong & Hilton, 2014). For instance, a study in Iran revealed that a young clinician may struggle to read a manual sphygmomanometer if they are accustomed to a digital one, while a senior clinician may have difficulty operating a digital sphygmomanometer if they are used to a manual one (Nargesi *et al*., 2014). Misdiagnosis can also occur when a diagnostician misinterprets the readings of a device, leading to a faulty diagnostic decision (Kallioinen *et al*., 2015). Sometimes, faulty equipment can also lead to misdiagnosis if the diagnostician is unaware of the issue (Mishra *et al*., 2013).

University of Ghana http://ugspace.ug.edu.gh

2.8.6 Health financing and misdiagnosis

The financing of healthcare can impact how patients access and use healthcare services. Many countries, including Uganda, have implemented free healthcare policies in public healthcare facilities, which has led to an increase in healthcare utilisation, particularly when there are no gatekeeper systems in place (Hajjaj *et al*., 2010). However, this increase in utilisation may have unintended consequences on diagnostic accuracy, as more patients may present with superfluous conditions, increasing the workload of diagnosticians and potentially leading to misdiagnosis. This increase in patient volume may also lead to changes in diagnostician behaviour, such as rushed consultations, inadequate medical histories, and poor patient engagement, all of which can contribute to misdiagnosis.

Furthermore, it has been reported that having insurance coverage can incentivise physicians to intentionally misdiagnose patients to receive reimbursement (Dong *et al*., 2020). This may occur when a patient's actual disease would not result in a high reimbursement, prompting the physician to exaggerate the severity of the illness to receive a larger payment. In other cases, the physician may collude with the patient by attributing symptoms that the patient does not have to obtain coverage for treatments that the insurer may not cover (Lagay, 2000; Wu *et al*., 2021). Some doctors may also modify the patient's billing codes to increase reimbursement (Rock *et al*., 2000).

Some literature suggests that there is a connection between health financing and diagnostic error, with diagnostic accuracy increasingly becoming a consideration in payment mechanisms (NAM, 2015). Certain healthcare organisations tie physician payment to the accuracy of diagnoses made in emergency departments, particularly for conditions that are commonly misdiagnosed, such as congestive cardiac failure and stroke (Berenson *et al*., 2014b). Similarly, Das *et al*. (2018) found

University of Ghana http://ugspace.ug.edu.gh

that physician practices varied depending on the financial incentives associated with patient interactions. When patients were expected to purchase medications outside of the hospital, physicians tended to prescribe fewer antibiotics compared to when medications were available in-house. Therefore, if diagnosticians are incentivised based on the accuracy of their diagnoses, they are likely to put forth greater effort in making the best possible diagnostic decisions (Das *et al*., 2018).

Various payment methods are used to compensate healthcare workers, such as salary, capitation payment, fee for service, and global budgets (Chi *et al*., 2014). These payment methods can impact physician behaviour in various medical practices, including diagnostic procedures, prescriptions, and referrals. Capitation payment, in particular, is seen as a potential health service purchasing mechanism that could enhance diagnostic accuracy. This is because, with a fixed payment for each patient, an organisation bears the cost of any diagnostic errors (NAM, 2015). Therefore, it is assumed that an organisation will take steps to reduce diagnostic inaccuracies.

Prospective payment mechanisms like capitation or global budget may lead to withholding of certain expensive investigations, which may prevent clinicians from ordering vital diagnostic tests that could contribute to making the best diagnostic decision (Tan & Melendez-Torres, 2018). However, fee for service payment mechanisms allow for greater flexibility in ordering tests, potentially enabling diagnosticians to obtain more information for decision-making (NAM, 2015). Fee for service may also increase the incidence of false positive and negative results, compounding the diagnostic decision-making process and leading to misdiagnosis or overdiagnosis (Berenson & Singh, 2018; Lam *et al*., 2020). Additionally, physicians may be incentivised to retain patients

University of Ghana http://ugspace.ug.edu.gh

rather than refer them for further opinions, which could further exacerbate diagnostic errors since it denies the patient the opportunity to get a better diagnosis if a second opinion would reveal otherwise (Gosden *et al*., 2006). There is dearth of information about how salary, impacts diagnostic accuracies in hospitals (Quinn *et al*., 2020a).

Some innovative provider payment mechanisms, such as Pay for Performance (P4P), Performance-Based Contracting (PBF), and Results-Based Financing (RBF), have been introduced to improve healthcare quality, but there is still a lack of evidence to confirm whether diagnostic accuracy is among the quality-of-care components targeted by these initiatives (Berenson & Singh, 2018). Alternative Payment Models (APMs) have also been proposed to address diagnostic accuracy, with physicians rewarded based on their diagnostic performance thorough periodic audit of the diagnosis coding, which is comparing the performance of the various diagnosticians. Nonetheless, there is still limited information on how APM has affected diagnostic decision-making in countries where it has been (Beronson & Singh, 2018a; Chi *et al*., 2014; Quinn *et al*., 2020a).

2.9 Theoretical frameworks

Theories and frameworks guide research conduct. In this study, the Safer Dx framework (Singh & Sittig, 2015) and the health systems building blocks (WHO, 2017) were adopted to explain health system factors associated with patient misdiagnosis in hospitals.

2.9.1 The safer Dx framework and misdiagnosis

The "Safer Dx Framework" was used in this study to investigate misdiagnoses (Singh & Sittig, 2015). A Safer Dx framework is used for defining, evaluating, and improving the diagnosis process

University of Ghana http://ugspace.ug.edu.gh

by examining its structure, process, and outcomes. It is based on Donabedian's (1988) model for measuring and improving healthcare quality. The Safer Dx framework was considered appropriate for this study because it identifies measurable variables that can be obtained from patient records or explained. By analysing diagnostic errors from the perspective of this framework, it challenges the popular belief that only diagnosticians are responsible for diagnostic errors (Singh, 2018). The framework is depicted in figure 2.1 below.

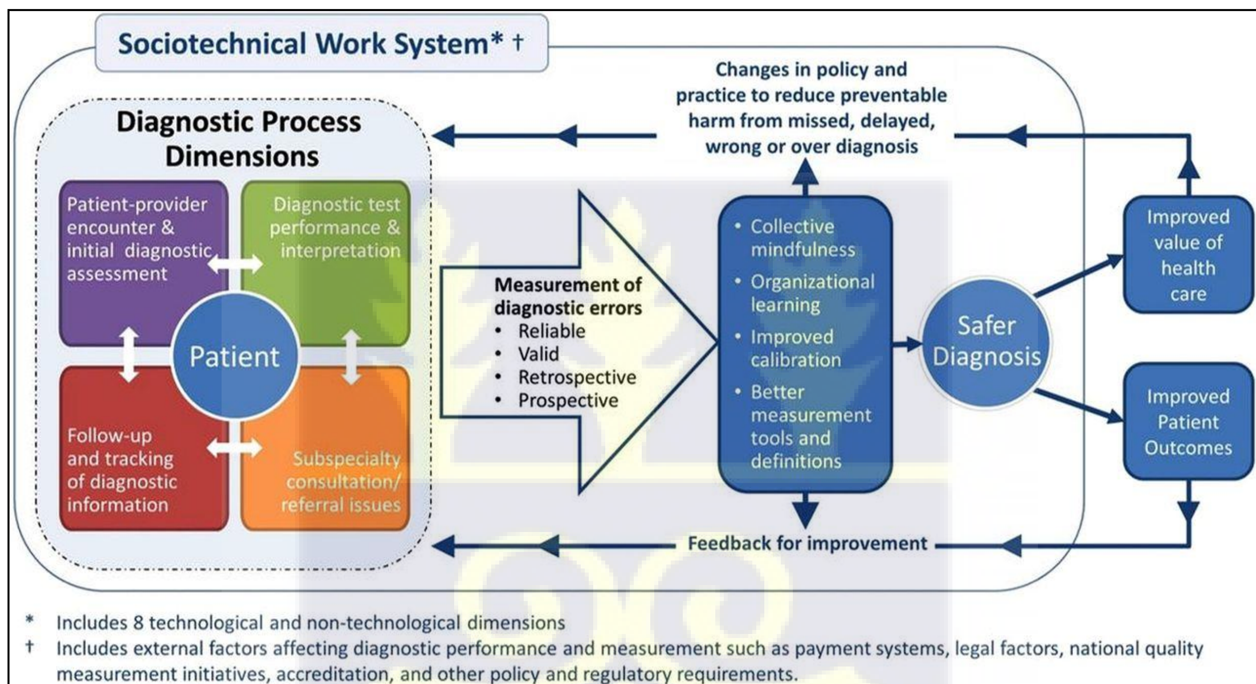


Figure 2.1: The Safer Dx Framework. Source: Adopted from Singh and Sittig (2015, p. 104).

The key components of the Safer Dx framework (structure, process, and outcomes) have been presented below.

Structure

Patient diagnosis is influenced by a variety of factors, including tools and technology, rules, regulations, policies, patient safety culture, the human resources involved in the process, materials,

University of Ghana http://ugspace.ug.edu.gh

and the environment of care (Singh & Sittig, 2015c). All activities during the diagnostic process should be focused on the patient being treated (Singh, 2018a).

The processes

The process dimension encompasses activities that occur during healthcare providers' interaction with the patient, interpretation of diagnostic tests, and use of information generated throughout the encounter (Rabie *et al*., 2017). These activities include history taking, patient examinations and assessments, and potential investigations. Investigation processes involve ordering and conducting tests, releasing results, and interpreting them, with the possibility of seeking consultations before making a final diagnosis. The process dimension also includes follow-up and referral systems and processes for patients (Singh, 2018b).

The outcomes

The main outcome of diagnostic processes is the right diagnosis. The outcomes are classified into main and intermediate outcomes (Singh & Sittig, 2015b). However, sometimes the process may not proceed as planned, leading to a wrong, missed, or delayed diagnosis. Achieving the right diagnosis should be done with minimal resources. This is the desirable intermediate outcome of the diagnostic process as explained in the framework (Singh, 2018b). Undesirable outcomes of the diagnostic process may include misdiagnosis, which may lead to patient harm, longer hospital days, unnecessary admission, costly treatment, anxious patients. depressed health workers, lack of trust in the services of the hospital involved, and sometimes death of the patients involved (NAM, 2015).

University of Ghana http://ugspace.ug.edu.gh

Measuring diagnostic error

The framework suggests that both valid, reliable retrospective and prospective methods can be used to measure diagnostic error. The results of the diagnosis measurement should aim at stimulating organizational learning from the error, with all health workers being aware of and paying attention to this (collective mindfulness). Error measurement should guide the implementation of measures that can contribute to diagnostic improvement. This includes putting tools and technologies in place to guide this improvement. All of these should lead to a safer diagnosis, which should also lead to better patient outcomes and improved health. The framework further emphasises that this should not be a one-way venture but a continuous process leading to a change in organizational policies and practices aimed at reducing diagnostic error.

Complexities in measuring diagnostic error

The Safer Dx Framework acknowledges that diagnosis occurs under various healthcare system complexities, which must be put into context when measuring it (Singh, 2018a).

2.9.2 Patient Misdiagnosis through the Health Systems Building Blocks Framework

Diagnosis is a complex procedure involving various people and processes in what is termed a system (Croskerry *et al.*, 2017). The occurrence of misdiagnosis is in part influenced by many failures or flaws in the health system (Croskerry *et al.*, 2017). It is upon this that the factors associated with misdiagnosis were reviewed and guided by the health system building blocks in this thesis. Health system building blocks include health service delivery, leadership, and governance, human resources, health information systems, access to essential medicines and

University of Ghana http://ugspace.ug.edu.gh

technologies, and leadership and governance (WHO, 2007). This research attempted to show how the different health systems' factors converge to cause misdiagnosis.

Service delivery

In the health systems building framework lens, service delivery refers to providing effective, accessible, and high-quality health care (WHO, 2007). This includes how services are run, how different illnesses are handled, how care is organized, including referrals and counter-referrals, what measures are taken to ensure quality service delivery, and how communities are involved in care provision. Meaningful initiatives to involve patients in the diagnostic process and their overall care are a core service component of the healthcare system for delivering effective patient diagnosis (Croskerry *et al*., 2017). This includes performing appropriate tests and procedures, taking a proper history and examination, and ensuring that all hospital support services relevant to diagnostic processes, such as laboratory services and blood banking, are operational (NAM, 2015). Failure of these components of the service could lead to patient misdiagnosis.

Health workforce

The health workforce encompasses all those engaged in actions intended to improve health and is a critical building block of any health system. Among them are doctors, nurses, midwives, community health workers, pharmacists, laboratory technicians, health educators, support staff, and administrators who ensure health services' smooth operation (WHO, 2007). Quality health care delivery requires a skilled, motivated, and adequately distributed workforce. The quality and accessibility of healthcare services directly depend on the training and supervision of healthcare workers (WHO, 2007). These employees should be placed in positions where their expertise can

University of Ghana http://ugspace.ug.edu.gh

be harnessed to make an accurate diagnosis. Medical personnel required for the diagnostic procedure must work collaboratively, collectively, consultatively, and collegially. Collaboration necessitates the teamwork of the critical health workers needed for an effective diagnostic outcome to ensure the correct diagnosis is established (Croskerry *et al*., 2017). Before making a diagnosis, the team requires the aggregation and synthesis of various staff members' ideas (Taylor, 2010).

Diagnosticians need to consult with each other to ensure they are making the right decisions. This means that they should seek advice from other staff members, especially those they feel are more experienced and have the requisite expertise in a particular service (Winters *et al*., 2012). This requires effective information sharing and intelligence gathering within the diagnostic team. It may also require the introduction of effective continuing education methods that improve diagnostic competence, especially for advancing knowledge, changes, and innovations in the diagnosis process (Warrick *et al*., 2014).

Health information Systems and Technology (HIT)

Health information systems (HIS) provide the data and insights to make effective decisions, monitor, and plan. Health providers, policymakers, and stakeholders can use HIS to assess health services' performance, track disease outbreaks, allocate resources efficiently, and understand population health trends (WHO, 2007). HIS includes all components and procedures organised to generate vital information for diagnostic decision making and patient management (El-Kareh *et al*., 2013). This is at the individual and healthcare system levels. A health information system aids in patient information collection.

University of Ghana http://ugspace.ug.edu.gh

It is critical to obtain a thorough history from the patient. Failure to do so may result in misdiagnosis. In other cases, point-of-care guidelines and protocols are used to aid in patient information collection. A functional HIT also allows for the exchange of information to guide the diagnostic process, including the efficient exchange of referral information (El-Kareh *et al*., 2013).

HIT supports diagnostic processes in institutions by collecting, storing, analyzing, displaying, and reporting diagnostic errors. Some technologies and tools, particularly computer-based ones, are available to aid in information gathering and synthesis (El-Kareh *et al*., 2013). Tools that aid in the identification of potential disorders that may be causing the patient's signs and symptoms are among them. Other information tools may aid in diagnosticians' collaboration, and technology exists to aid in diagnostic errors tracking, particularly through algorithms. Misdiagnosis is more likely when the tools listed above are absent or malfunctioning.

Medical products, vaccines, and technologies

Medical products, vaccines, and technologies refer to the essential tools and resources for preventing, diagnosing, treating, and managing health conditions. Among the items this building block covers are medications, vaccines, diagnostic tools, medical devices, and other health technologies, as well as the policies and systems that ensure their availability, accessibility, quality, and proper use (WHO, 2007). Medical technologies and equipment play a vital role in diagnosis. Effective technology-driven diagnosis necessitates modern and functional diagnostic equipment, including technologies used in patient examination, laboratory screening, and investigation, as well as radiology tools (Croskerry *et al*., 2017). Medical staff should be able to operate and interpret these equipment (Vincent *et al*., 2013). Faulty or unavailable technologies endanger diagnostic procedures. Previous research, for example, revealed that most of the diagnostic

University of Ghana http://ugspace.ug.edu.gh

equipment in Sub-Saharan African hospitals were defective and may not be used when needed (Mahumud *et al*., 2016).

Leadership and governance

Leadership and governance represent the major health system building block that guides and directs all other components. This building block provides the foundation for a strong health system, by ensuring effective, equitable, and responsive health services for the population as well as guaranteeing that other health system components function efficiently and align with national health goals and values (WHO, 2007).

Leadership is crucial to ensure an atmosphere cognizant of quality healthcare delivery (Croskerry *et al*., 2017). Effective leadership is essential at all levels of the healthcare system and is manifested through implementing specific healthcare-level policies aimed at facilitating safe diagnosis and diagnostic error prevention (Vincent *et al*., 2013). Leadership should create awareness about safe diagnosis and diagnostic errors and organise duties to ensure error prevention (Gill & Bailey, 2010).

Putting in place incentives that reward individuals, departments, and institutions that perform at the highest quality levels will be key to stimulating high quality performance (Khullar *et al*., 2015). This will require systems that measure and track performance to learn from successes and failures (Vincent *et al*., 2013). This also goes hand in hand with the support and supervision of all those involved in the diagnostic processes. It ensures that they are facilitated to do a good job. A lack of all these among the leaders coupled with poor coordination and governance is likely to create an organisation where diagnostic error is inevitable.

University of Ghana http://ugspace.ug.edu.gh

Health Financing

Health financing includes all methods of collection or raising health funds, pooling them, and allocation of revenue to purchase health services (WHO, 2007). Certain funding from benefactors, for instance, has been allocated specifically for HIV/AIDS and tuberculosis services (NAM, 2015). This allocation enables patients suffering from these diseases to be provided with high-quality healthcare, particularly for the diagnosis of HIV and opportunistic infections associated with HIV, such as tuberculosis and cryptococcal meningitis (NAM, 2015). The method of payment to healthcare providers can potentially influence their behaviour, leading to diagnostic errors (Beronson & Singh, 2018). For instance, when compensation is linked to the volume of procedures performed or tests ordered, there might be a tendency among healthcare workers to order more tests than required (Quinn *et al*., 2020).

This could lead to overdiagnosis or unnecessary procedures. Conversely, if the payment model encourages quick patient turnover, it could lead to hurried diagnoses and consequently, misdiagnoses (Ginsburg *et al*., 2009). In both cases, financial incentives might overshadow the primary objective of delivering accurate and patient-focused diagnoses, thereby affecting the quality of care (Gosden *et al*., 1999). Moreover, the financial implications of tests and investigations might influence a patient's decision to undergo them. These factors could collectively impact the diagnostic decision-making process and its outcomes (Gosden *et al*., 2006).

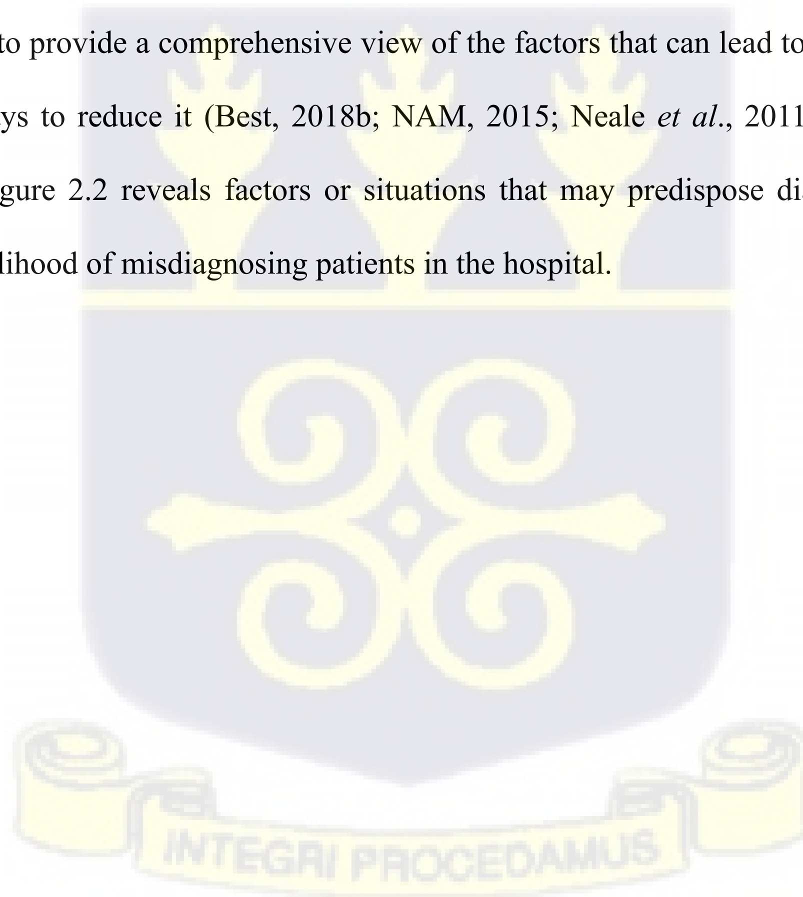
2.10 Theoretical triangulation: Conceptual framework for system factors pathway to patient misdiagnosis

There was the need for a theoretical triangulation as it was clear that one theory alone could not explain the findings of the study due to the complexities regarding misdiagnosis, The theory of

University of Ghana http://ugspace.ug.edu.gh

Safer Dx Framework was interrelated with the health systems building blocks to examine misdiagnosis. The conceptual framework thus, provides a comprehensive understanding of the diagnostic process and its components by considering elements like individual, disease/case-related, and system factors, access to health services, health workforce, health information systems, and technologies.

By using this framework, researchers and healthcare providers can identify the root causes of misdiagnosis and implement targeted solutions to improve diagnosis accuracy and patient outcomes (NAM, 2015; Singh *et al*., 2014). The conceptual framework considers the health system building blocks to provide a comprehensive view of the factors that can lead to misdiagnosis and the potential ways to reduce it (Best, 2018b; NAM, 2015; Neale *et al*., 2011). The conceptual framework in figure 2.2 reveals factors or situations that may predispose diagnosticians to or increase the likelihood of misdiagnosing patients in the hospital.


INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

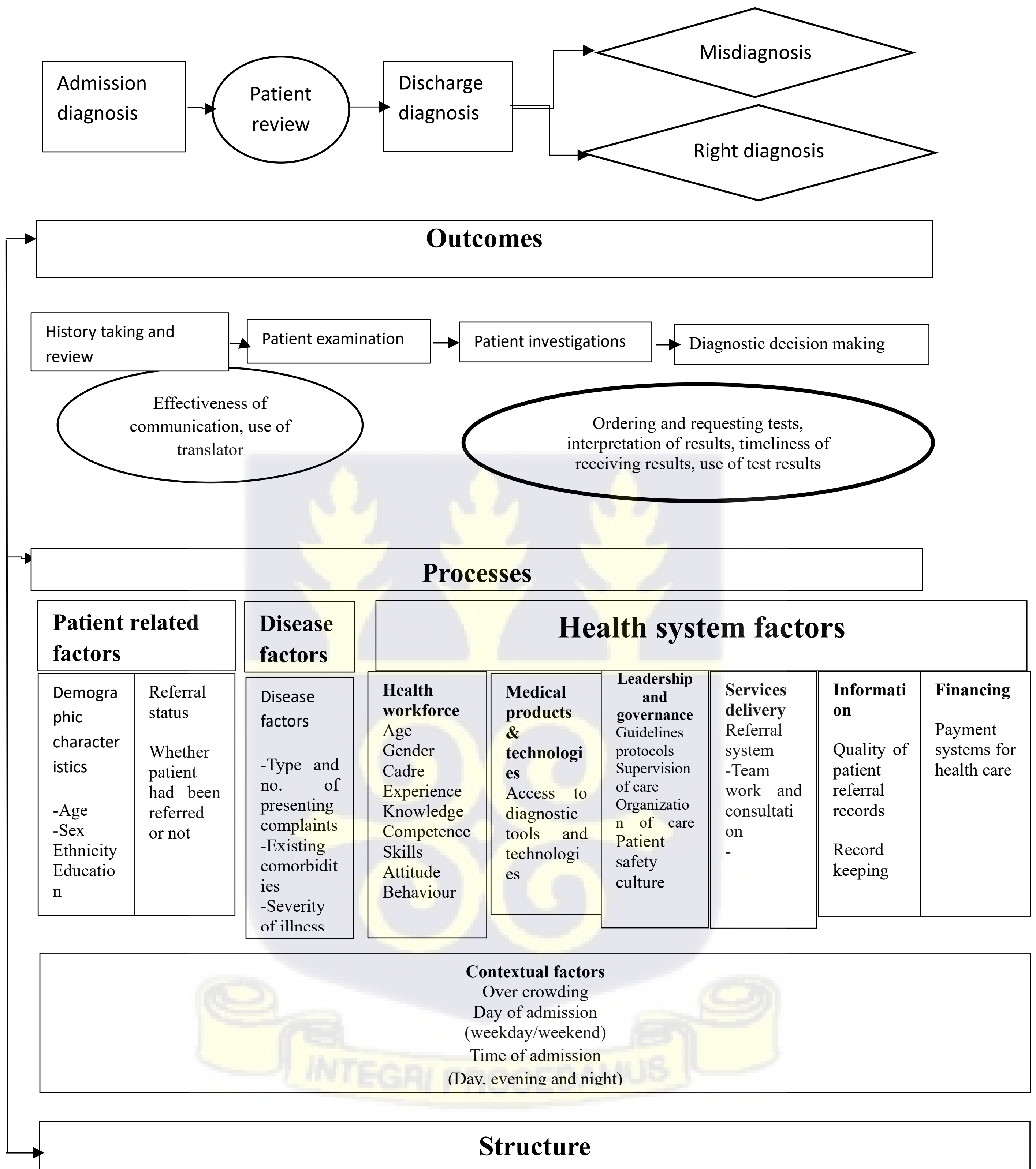


Figure 2.2: Theoretical triangulation: Conceptual framework for system factors pathway to patient misdiagnosis.

University of Ghana http://ugspace.ug.edu.gh

Patients' factors such as age, gender, culture and beliefs, ethnicity, education, timely seeking of medical care, and income level can impact the diagnosis process (Epstein, 2019; Mohamed *et al*., 2016). Some patients may tend to delay seeking medical care due to financial constraints or lack of insurance. This can result in a delay in treatment, making it difficult to diagnose their conditions. These patient-related factors can lead to poor health-seeking behaviours and result in late reporting to hospitals (Schiff *et al*., 2005). The diagnostic process is significantly impacted by how a patient interacts and cooperates with medical professionals, particularly during the history-taking procedure. The patient's entry into the hospital or referral from a primary care facility are two additional patient-related factors (Kaisey *et al*., 2019; Lighthall & Vazquez-Guillamet, 2015; Mohamed *et al*., 2016).

Patient symptoms and signs and the severity of their condition can increase the likelihood of misdiagnosis (Kostopoulou *et al*., 2008). The lack of a differential diagnosis and rare conditions are also contributing factors to misdiagnosis (NAM, 2015; Maude, 2014). These disease-related factors can impact the accuracy of the diagnosis made by healthcare providers. Good clinical practice dictates that prompt testing is essential for accurate diagnoses, and that laboratories and imaging services must ensure the accuracy of their results (Forjuoh *et al*., 2013; Singh *et al*., 2019). Misdiagnosis can occur due to mistakes in test selection or interpretation, delays in receiving results, or incorrect utilisation of test results (Croskerry *et al*., 2017). To avoid misdiagnosis, standard operating procedures should need to be followed during the diagnostic process.

The diagnostic process' quality is determined by the availability of adequate and competent health personnel (Croskerry *et al*., 2017). Staff shortages in outpatient and emergency departments can increase workload and increase the likelihood of errors (Warrick *et al*., 2014). The experience, and

University of Ghana http://ugspace.ug.edu.gh

cognitive abilities of health workers all influence diagnosis accuracy (Berner & Graber, 2008). These skills are related to their work experience and education (WHO, 2016). The attitude and behaviour of diagnosticians toward patients can also influence misdiagnosis, particularly with difficult patients (Sandikci *et al*., 2017). The importance of teamwork in the diagnostic process to reduce misdiagnosis is emphasised. Health workers in the laboratory and radiology departments are critical to the process and must collaborate and consult with one another to ensure accurate results (NAM, 2015a; Graber, 2013a).

To accomplish this, hospitals would need to put in place systems that promote teamwork and communication among all departments involved in the diagnostic process. Diagnosticians need access to the right tools and equipment, including well-equipped laboratory and investigation departments, to make accurate diagnoses. The laboratory and radiology departments should be able to provide reliable results to guide the diagnostic process (World Health Organization, 2016). Any errors made in the investigation of patients' illnesses can impact the diagnostic decision-making and result in misdiagnosis (Schiff *et al*., 2005).

The leadership of the hospital should prioritise the importance of accurate diagnosis as an aspect of the hospital's quality and safety and allocate resources accordingly. Without proper policies and a patient safety culture that prioritise diagnosis, misdiagnosis may occur (NAM, 2015). The leaders should foster a safety culture that encourages reporting and discussing of diagnostic errors to prevent future errors. Punishing individuals involved in errors may discourage the sharing of knowledge and prevent learning opportunities, leading to a higher likelihood of future errors (Yu *et al*., 2016).

University of Ghana http://ugspace.ug.edu.gh

The diagnostic process requires the use of information technology and effective data management entailing gathering comprehensive information from patients and sharing it with those involved in the diagnostic process (Hackmann *et al*., 2019). Language barriers can alter mental state, unclear records, and a lack of information sharing among diagnosticians can all lead to misdiagnosis (Dogether *et al*., 2016). The use of diagnostic support tools for information gathering, analysis, and sharing can greatly benefit the diagnostic process and reduce the occurrence of misdiagnosis. The environment in which a diagnosis takes place can impact the accuracy of the diagnosis, including factors such as the physical space, time constraints, and patient overcrowding. Patient overcrowding occurs at specific days of the week and times of the day (Vincent *et al*., 2013). Overcrowding and boredom among clinicians can impair their cognitive ability and lead to misdiagnosis.

The conceptual framework suggests that when patients visit the outpatient department, their condition is assessed through a process of taking their history, examining them, conducting investigations, and evaluating the results to make a diagnosis that determines their treatment plan (Schultz & Doty, 2016). A senior physician assesses the patient upon admission, and the diagnosis may be updated after further review. In the patient's treatment records, both the admission and discharge diagnoses are recorded. The final diagnosis for the patient's condition that led to their hospitalisation is the result of the diagnostic process (NAM, 2015). Misdiagnosis occurs when an incorrect diagnosis is made and then corrected (Graber *et al*., 2005). A misdiagnosis is defined as a difference between the admission and discharge diagnoses (Schiff, 2009). This can have an impact on the patient's healthcare quality because it may result in changes to their treatment plan (Macfarlane, 2008). The reasons for misdiagnosis have already been discussed in the chapter.

University of Ghana http://ugspace.ug.edu.gh

2.11 Chapter summary

The analysis of existing literature suggests that prior research on patient misdiagnosis has primarily relied on autopsy findings, voluntary error disclosures, and malpractice claims. However, the full scope of the misdiagnosis remains uncertain. Most literature concerning the causes of misdiagnosis is largely rooted in assumptions and interpretations by physicians and psychologists, lacking substantial data from real hospital patient records. Consequently, the link between elements of the healthcare system and misdiagnosis remains ambiguous. The chapter concludes by introducing the integrated framework that guides the study, combining the "Safer Dx Framework," a derivative of Donabedian's healthcare quality model, and the WHO's health systems building blocks. The subsequent chapters will provide a detailed exposition on the research methodology.

University of Ghana http://ugspace.ug.edu.gh

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The chapter presents the research methodology with four main sections. Section one presents the philosophical assumption where the critical realism research paradigm is espoused. Section two presents the research methodology. The subsections within this section are quantitative research methods, qualitative research methods, and mixed methods approach. Section three presents the research design and strategy. Here, the subsections include research design (cross sectional design and case study approach), study area, study population (inclusion and exclusion criteria for the medical records and health workers), sample size determination for patients records and selection of number of health workers, sampling technique for hospitals and patients' records and purposive sampling of health workers, study variables (dependent and independent variables).

Other subsections are data collection (quantitative data to obtain misdiagnosis, patient related factors, disease related factors, environmental (contextual) factors, and misdiagnosed disease categorization), qualitative data collection (in-depth interviews), quality assurance, data management and analysis (quantitative data analysis and qualitative data analysis). Section four presents the ethical considerations. The chapter ends with a summary of the main ideas and a projection of what follows in the subsequent chapter.

3.2 Philosophical assumption

This section presents the philosophical assumption based on which the research methodology was selected for the conduct of this study. Knowledge-seeking follows several processes, including specifying how the research problem and research questions will be studied, and how the

University of Ghana http://ugspace.ug.edu.gh

information will be obtained and interpreted to answer the research question (Kivunja *et al*., 2017). Kivunja *et al*. (2017) explain that these processes are called research paradigms or philosophical foundations of research. It is the core beliefs and ideas that underlie the research process used and therefore, there is a need for each researcher to provide and clarify the approach used to conduct the research (Scotland, 2012). Philosophical paradigms include epistemology, ontology, axiology, and methodology (Cresswell, 2014; Sanders *et al*., 2015).

The two main components of a research paradigm are epistemology and ontology. The purpose of epistemology is to clarify how researchers gain knowledge of phenomena or realities (Garada, 2015; Kivunja *et al*., 2017 Salazar *et al*., 2015). Epistemology, in its broadest sense, is concerned with the validity, scope, and methods used to seek and impart knowledge (Gray, 2009). Ontology describes the existence of certain realities in the world about which researchers can make truths or claims. Basically, this involves looking at the existing reality that can lead to contradictory conclusions (Salazar *et al*., 2006). This forces an investigator to study, understand, or experience it so that truth can be deduced from it. Conversely, it precedes reality (Kivunja *et al*., 2017). Saunders *et al*. (2019) explain that ontology clarifies what is in the world that researchers can learn about.

The methodology concerns the research project used to obtain the required knowledge of the concept under investigation (Scotland, 2012). Within the methodology, the researcher visualizes how to proceed with the collection of data, interpretation, analysis, and presentation of results. The process of collecting, interpreting, and presenting data to answer the research question (Meissner *et al*., 2013; Scotland, 2012). The methodology further includes the assumptions that the researcher

University of Ghana http://ugspace.ug.edu.gh

makes about the chosen project, as well as the limitations that may arise when using the specific research approach, including mitigation measures for identifying research limitations (Meissner *et al*., 2013).

Axiology refers to ethical issues in relation to how knowledge of the subject under study is acquired (Kivunja *et al*., 2017b). This includes knowing what is right or true when conducting a study. Saunders *et al*. (2019) add that axiology includes considerations of fairness and respect for people in the institutions where data is collected. It also reduces the risk of harm and injury to study participants. This study was based on the research paradigm of critical realism as explained below.

3.2.1 The critical realism research paradigm

The study was based on the critical realism research paradigm, which is a philosophical paradigm that explains the reality of what can be seen or measured (Cruickshank, 2012). Critical realism assumes truth lies at three levels (Fleetwood, 2014). Fleetwood (2014) explains that these layers are empirical (what is at the individual level, but can be measured or perceived analytically), real (what may be happening beneath what is seen, felt, and experienced, but is not apparent), and reality (the problems that explain how it leads to what is empirically observed) [(Walsh & Evans, 2014)]. In the description of causality, the real domain defines the fundamental cause of the whole research problem (Plant, 2001; Saunders *et al*., 2019; Scot, 2014).

In terms of epistemology, critical realism adheres to causality or trend-seeking (Shannon-Baker, 2016). Critical realism pronounces that it is certainly possible to forge a more comprehensive and lasting relationship between two or more events (Ryan, 2019). This explains the use of statistical

University of Ghana http://ugspace.ug.edu.gh

correlation and association models and predictive regression models, as well as other quantitative measures that relate to events (Mingers, 2003). The philosophy of critical realism also states that science is always looking for a deeper and simpler explanation of a reality that empirical findings may not explain (Jones, 2011; Walsh & Evans, 2014). In addition, realism contends that although some events can be felt or experimentally verified through statistical associations, empirical findings are only a small portion of what has been observed. It also argues that many life events cannot be reduced to mathematical models alone (Bhaskar, 2008; Saunders *et al*., 2019).

Misdiagnosis is a complex phenomenon that requires several approaches to determine why it occurs. Thus, the choice of the critical realism philosophical paradigm was based on its ability to explain specific causal relationships that may or may not have been empirically observed (Wynn & Williams, 2012). This study used records review to quantify the extent of the misdiagnosis. It also determined factors associated with the occurrence of misdiagnoses. However, there are several unclear interactions, mechanisms, and contextual variables that may explain the empirically observed phenomenon of misdiagnosis. The methodical approach supports the clarity and explanation of hypotheses incorporated into statistically significant and statistically insignificant quantitative findings of factors linked to misdiagnosis. It also helps classify commonly misdiagnosed conditions.

On the other hand, constructionism is used to define additional variables that may not have undergone statistical analysis (Shannon-Baker, 2016). However, they may have contextual justifications for misdiagnoses. The researcher acknowledges that as a clinician, the researcher participated in the diagnostic processes, occasionally reviewed his practice, and realised that some

University of Ghana http://ugspace.ug.edu.gh

diagnostic decisions resulted in misdiagnoses. Thus, the researcher knew that could be several contributing factors to a patient's incorrect diagnosis. To remove these biases, the researcher did not interfere with diagnosticians' practice, hence, the choice of records review and also sought explanations for the findings of the review.

3.3 Research Methodology

This section presents the research methodology, which was selected for the conduct of this study. As explained earlier, the methodology concerns the research project used to obtain the required knowledge of the concept under investigation where the researcher visualizes how to proceed with the collection of data, interpretation, analysis, and presentation of results (Scotland, 2012). The three most used research methodologies, which were suitable for the conduct of this study (quantitative research methodology, qualitative research methodology and mixed methods research) have been explained below.

3.3.1 Quantitative research methodology

Quantitative research methods were applied to collect data to analyse the prevalence and factors associated with misdiagnosis with a positivist philosophical stance in mind. This was done using a data abstraction form to determine the prevalence of misdiagnosis and the factors associated with misdiagnosis. The review of patients' records also gathered data on variables to establish misdiagnosis-associated factors. This design was also used to classify misdiagnosis and to construct the Pareto chart to establish diseases and diagnostic groupings that were commonly misdiagnosed.

University of Ghana http://ugspace.ug.edu.gh

3.3.2 Qualitative research methodology

The qualitative part of this study explored reasons and mechanisms why quantitative outcomes were associated with misdiagnosis. Constructivist-grounded in-depth interviews were employed in this qualitative phase to elicit rich, contextualized insights into the perceptions, opinions, and experiences of participants regarding the significant and non-significant variables associated with misdiagnosis, as identified in the quantitative phase. By utilizing qualitative research methods, this study aimed to explore and elucidate the complex attitudes, beliefs, situations, perceptions, and emotions of a specific group of individuals, providing a nuanced understanding of the research phenomena through descriptive thematic analysis (Creswell & Poth, 2018; Ranjit, 2019).

3.3.3 Mixed Methods Research Approach

With more qualitative investigation and analysis, the general picture drawn from quantitative results is extended and clarified. While it is acceptable to know the magnitude of the misdiagnosis problem for the health system, qualitative approaches were also necessary to understand this phenomenon. Vaismoradi *et al*. (2013) argue that qualitative approaches that attempt to understand the phenomenon from those who face it or are involved in it are relevant to an appreciation of a particular problem. Therefore, subjective experiences and views on significant predictors of misdiagnosis were solicited from diagnosticians/clinical staff who admit patients at the OPD. This means that the qualitative component was essential for exploring the misdiagnosis phenomenon from the diagnosticians' perspective (i.e., those directly involved in the diagnostic processes). In addition, the physicians who were selected were responsible for enrolling patients for an exit diagnosis interview in the Ugandan health sector.

University of Ghana http://ugspace.ug.edu.gh

Firstly, the quantitative method in this study was used to establish misdiagnosis prevalence, common misdiagnosed conditions and a regression analysis was conducted to identify factors associated with misdiagnosis. Thereafter, qualitative methods were used to explain the findings of the quantitative methods. The qualitative analysis established the understanding of the quantitative results by obtaining subjective experiences from diagnosticians who included clinicians and medical officers. This method helped to establish the understanding of significant associations of misdiagnosis found during the quantitative findings.

3.3.4 Research design

This study used explanatory sequential cross-sectional mixed-methods design. It is a mixed method because both quantitative and qualitative methods were used. If one of the quantitative or qualitative methods in a mixed method comes first, that method is sequential (Creswell, 2013). A cross-sectional study identifies the prevalence of characteristics (variables) of interest at a given time (Awaisu *et al*., 2019; Nour & Plourde, 2019). In the sequential explanatory mixed methods study, the quantitative approach is used first, which is followed by qualitative methods to explain the latter's findings (Meissner *et al*., 2011, 2013; Subedi, 2016). The choice of explanatory sequential mixed methods research design enabled the researcher to apply both a descriptive cross-sectional design and a case study research approach as explained below.

Case study method research approach

This study used a multiple case-study research approach to provide explanations for the misdiagnosis phenomenon. Yin (2014) proposes that a case study design allows data to be collected using numerous methods on a small number of study subjects and it is used to make holistic conclusions. The case study method was used on multiple cases (hospitals) to generate a broader understanding of the phenomenon of misdiagnoses in some hospitals. The multiple case study

University of Ghana http://ugspace.ug.edu.gh

approach was relevant for this study as it allowed for studying patient misdiagnosis across diverse healthcare settings. In doing so, this helps to understand misdiagnosis concepts from a diverse context. This approach further improved external validity of findings through comparisons across various hospitals.

3.3.5 Study area

The study was conducted in five hospitals in five districts in Central Uganda. A brief description of Uganda in terms of geography, demography, epidemiology, economic status and healthcare provision/studied hospitals is provided below.

Geography of Uganda

Uganda is a landlocked country with a total area of 241,040 square kilometres (93,066 square miles) located in East Africa, bordered by South Sudan to the north, Kenya to the East, Tanzania to the south, Rwanda to the South-West, and the Democratic Republic of Congo (DRC) to the west. It has a predominantly tropical climate with consistent temperatures all year-round (King, et al., 2024)

Demographic

Uganda's estimated population in 2021 was 42.9 million constituting 49.2% males and 50.8% females (National Population Council, 2021b). With a fertility rate of 5.01 and a population growth rate of 3.03, Uganda has one of the youngest populations in the world, with 75% of the population under 35 years of age. Children under 18 years make up 54.7% of the population (Ministry of Finance, Planning and Economic Development, 2018).

University of Ghana http://ugspace.ug.edu.gh

Epidemiology of Disease

The following epidemiological statistics were available as at the year 2018: Infant and child mortality rates (43/1000), maternal mortality rates (64/1000), and life expectancy (63.3 years) in Uganda, and maternal mortality ratio of 336 per 100,000 live births (Uganda Bureau of Statistics (UBOS) and Inner-City Fund (ICF), 2018). The main causes of morbidity and mortality are malaria, cough, cold, intestinal worms, and acute diarrhoea, while the main causes of death in children under five are malaria, anemia, and pneumonia (Ministry of Finance, Planning and Economic Development, 2018).

Economic status

The working population in Uganda was estimated to be approximately 15 million where over 64% of these were employed in subsistence farming in 2019 (Uganda Bureau of Statistics (UBOS), 2020a). In 2019, Uganda's poverty rate stood at 41% (UBOS, 2019). In 2020, the unemployment rate was estimated at 4.22% (UBOS, 2020b). Approximately 80% of women in Uganda were engaged in agricultural activities, with 42% serving as unpaid family workers, a significantly higher proportion than men at 16%. Women in the country generally, earn lower wages than their male counterparts (UBOS, 2019). The salaries of female workers in traditionally male-dominated fields are comparable to those of their male counterparts and, notably, three times higher than those of other women. As of 2018, 3.22% of industrial sector employees were women (UBOS, 2019).

Healthcare Provision/Selected Hospitals

Healthcare is provided to the population through different levels of health facilities in Uganda. Public hospitals were considered for this study as most policy decisions on disease diagnosis in

University of Ghana http://ugspace.ug.edu.gh

Uganda focus primarily on public hospitals and because they treat many patients - over 60% of hospitalisations in Uganda (Mbonye *et al*., 2014; Mukasa, 2012b; Ministry of Health, 2014). Additionally, public hospitals account for 69.6% of all hospital admissions (Institute for Health Metrics and Evaluation (IHME), 2014c). In addition to other defined criteria, simple random sampling method (Bhardwaj, 2019) was applied to select five general hospitals out of the nine available in Central Uganda. General hospitals also represent the mid-level health system, which treat most patients.

The five health facilities selected for this study were: Kiboga Hospital, Nakaseke Hospital, Mityana Hospital, Gombe Hospital, and Kayunga General Hospital located in Mityana, Butambala, Nakaseke, Kiboga, and Kayunga districts of central Uganda. These hospitals have been anonymised as H1, H2, H3, H4 and H5 respectively. Each of these hospitals serves as a district referral hospital for secondary and tertiary care in their own district and neighboring districts. The general hospitals also serve as the primary health care centre for outpatient services for communities in which they are located.

In addition to hosting two-thirds of Uganda's health workforce, the Central Region of Uganda hosts the capital town of Uganda, which is Kampala (Namaganda *et al*., 2015). Despite a 150-bed capacity, the study hospitals sometimes admit more patients. The hospitals provide a variety of services, including outpatient care, in-patient care/hospitalisation, HIV/AIDS and Tuberculosis care, and surgery. The 2019/2020 staff audit report showed the hospital staff numbers in Uganda (Ministry of Health, 2020b). For instance, three hospitals, H1, H5, and H5, were staffed at less than 80% capacity. Appendix I is a map showing hospital locations in Uganda. The hospital staff numbers for 2019/2020 are displayed in Table 3.1.

University of Ghana http://ugspace.ug.edu.gh

Table 3.1: Analysis of the 2019/2020 financial year staffing in the hospitals

Facility	Approved positions	Positions Filled	Positions Vacant	% Filled	% Vacant
H1	190	146	44	77	23
H2	190	183	7	96	4
H3	190	200	0	105	-5
H4	190	122	68	64	36
H5	190	127	63	67	33

Source: Extracted from the 2019/2020 Uganda Human Resources for Health audit report

3.5 Study population

The general population of the study constituted patients and health care workers in the selected hospitals. The health provider population consisted of those selected from the selected hospitals while the patient population consisted of patients admitted at the medical male and female wards as well as in the paediatric wards of the five selected hospitals from 1st July 2019 to 30th June, 2020. The target patient population was all patients whose admission was done at the outpatient or emergency department and were not admitted due to surgical or obstetric conditions (conditions related to pregnancy, childbirth and the postpartum period). The patient population in this study was selected using the records of patients that were retrieved for review.

Inclusion criteria

The criteria used to qualify health workers and patient folders for inclusion in the study were;

1. Records of patients who had been admitted through the outpatient or emergency department as an inpatient with a medical condition.

University of Ghana http://ugspace.ug.edu.gh

2. Health workers who were employed at one of the selected hospitals at the time of the study.
3. The health workers should have had a minimum of two years' experience as clinical officers or medical officers at the specific operating hospital.

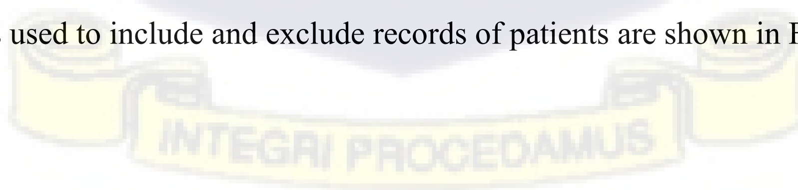
Records of patients who after hospitalisation were jointly evaluated by a team of health professionals led by a physician (medical officer), who finally formulated the final diagnosis. This is the diagnosis on the discharge form. There was no age limit on the patient records being reviewed.

Exclusion criteria

The criteria used to disqualify health workers and patient folders for inclusion in the study were;

1. Records of patients with incomplete or missing key information, such as symptoms, diagnostic tests, or treatment plans, which made records unreliable for a comprehensive analysis of the patient's condition.
2. Patient records that were unclear or challenging to read and understand.
3. Health workers who did not consent to be interviewed or were ill at the time of the interview.
4. Health workers who fell within the inclusion criteria but were not available at the time of the interview.

The steps used to include and exclude records of patients are shown in Figure 3.1.



University of Ghana http://ugspace.ug.edu.gh

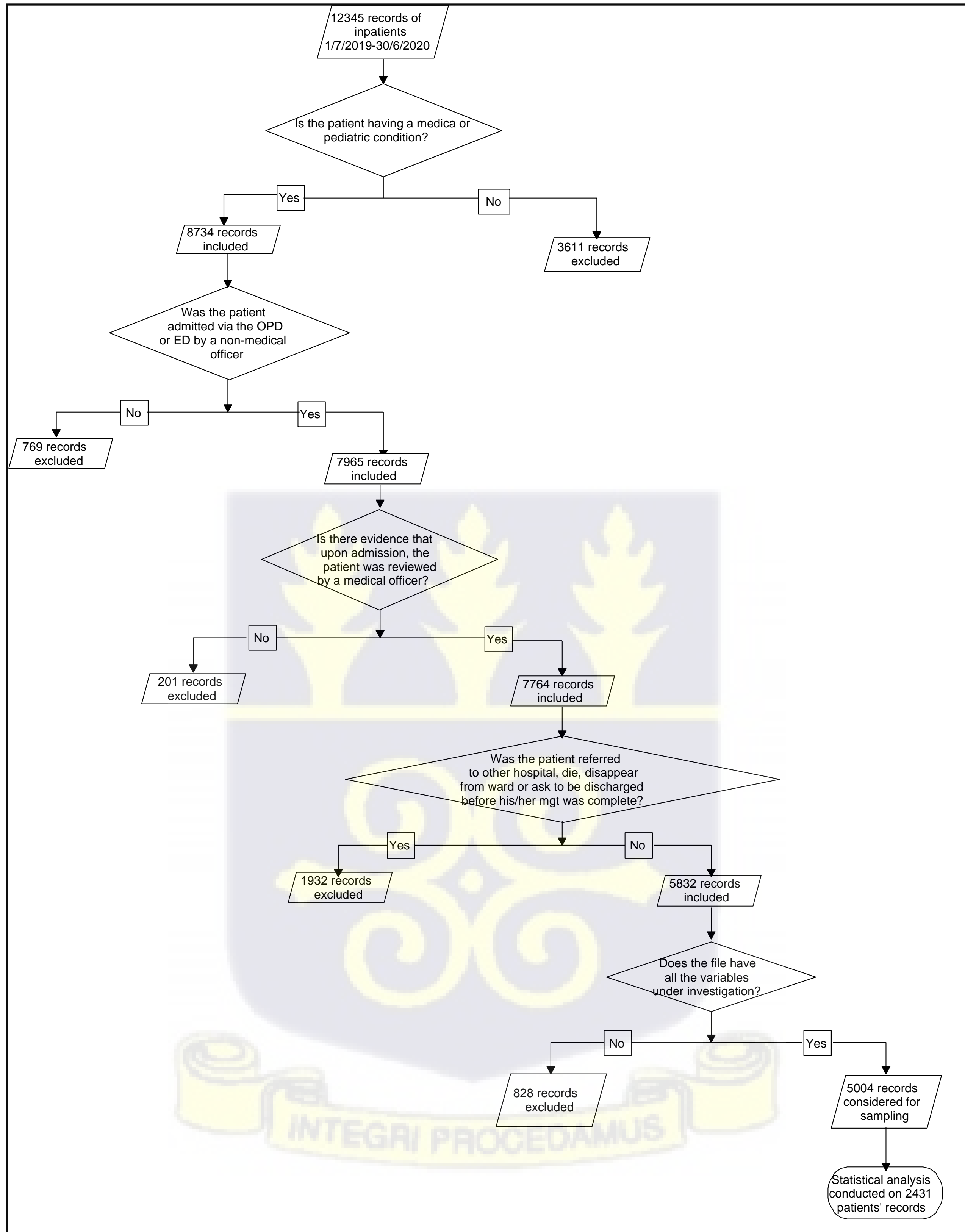


Figure 3.1: Selection criteria of the patient records for data extraction.

University of Ghana http://ugspace.ug.edu.gh

3.3.4 Sampling Strategies

This section presents the strategies used to determine the sample size for records of patients for the quantitative study and the selection of the number of health workers for the qualitative study.

3.3.5 Sample size determination

The sample size was determined based on the binary logistic regression model formula to identify factors associated with patients' misdiagnoses (Wynants & Calster, 2017). This sample size estimate based on logistic regression uses the concept of events per variable (EPV) to estimate the number of records examined depending on the ratio of the number of events to the number of variables studied (Wynants & Calster, 2017). Peduzzi *et al*. (1996) noted that for a given number of EPVs, at least, 10 cases per variable are necessary for logistic regression analysis. The sample size formula used to determine the required number of patient records was:

$N = 10\,k / p$

where;

p - represents the smallest of the proportions of the outcome, that is, either positive or negative cases in the population.

k - represents the number of covariates (the number of independent variables) that are associated with the outcome.

Patient misdiagnosis was the dependent and most significant outcome variable in this study. Previous studies reported that the proportion of patients misdiagnosed due to an experienced physician's opinion altering the initial diagnosis ranged from 5–15% (Kedar *et al*., 2003). Therefore, 5%, the lower proportion (p) was considered. The outcome of interest had binary results as to whether the patient was "misdiagnosed" or "not misdiagnosed" (correctly diagnosed).

University of Ghana http://ugspace.ug.edu.gh

Misdiagnosis occurrence was believed to be related to the twelve independent variables (explained in subsection 3.12.2) derived from the Safer DX framework and the reviewed literature. Therefore, the minimum number of medical records reviewed was calculated as:

N = 10 x 12/0. 05 = 2,400.

Following the "10 events per variable" philosophy, 120 misdiagnosed cases had to be identified among the 2,400 records for the review to be completed. To account for errors, incomplete records and unreadability based on the findings of the pre-test, 31 more records (1.29%) were examined than the calculated sample size. The minimum proportional method applied to allocate the estimated sample size to the five selected hospitals is displayed in Table 3.2.

Table 3.2: Minimum proportional patients' records reviewed

Hospital	Total number of records	Adult records		Paediatric records	
		Male	Female	Male	Female
HI	480	144	144	96	96
H2	480	144	144	96	96
H3	480	144	144	96	96
H4	480	144	144	96	96
H5	480	144	144	96	96
Total	2400	720	720	480	480

Selection of the number of health workers

Data saturation was used to determine the number of health workers expected to be included in the study. Guest *et al*. (2006) contends that typically, twelve interviews are conducted before saturation occurs. According to the same authors, information gathered from experts in a field tends to be more consistent than information gathered from non-experts, so it may only take a small number

University of Ghana http://ugspace.ug.edu.gh

of interviews to reach saturation (Guest *et al*., 2006). Additionally, it has been stated that when using a case study design, a sample size of four to five cases is required for qualitative research (Creswell & Creswell, 2018).

3.3.7 Sampling technique

This subsection explains the methods used to select the records reviewed, and the health worker participants of the selected hospitals.

Sampling of patients' records

Two sampling techniques namely, stratified and simple random sampling were used to select medical records as explained below.

Stratified sampling method

Stratified sampling is a random sampling method that divides the population into subgroups based on diversity. The stratification of patient records maximized the representativeness of the sample and accounted for variables relevant to the analysis that would be confounders in identifying factors associated with misdiagnosis (Peersman, 2014; Salazar *et al*., 2006b). The variables that guided the sampling included the hospital of admission as well as patients' age and gender. Three-stage stratified random sampling was used to ensure a representative sample of patient records.

Firstly, a proportionally stratified sample was used to ensure a comparable sample size, as all of these hospitals could accommodate 150 inpatients. Therefore, at least 480 hospital records from each hospital were considered. Second, to account for age representation in the sample, given that 40% of all hospital admissions in Uganda are children aged 0–9 years (Mukasa et al., 2012), 192 were paediatric (0–9 years aged) medical records, and 288 were for children aged 10 years and above in each hospital. During the sampling process, records of patients between 10 and 17 years

University of Ghana http://ugspace.ug.edu.gh

of age were included in the adult patient category. Although adulthood begins at 18 years of age by Ugandan practice, patients older than 10 years in Ugandan hospitals are admitted to the adult male and female wards (Institute for Health Metrics and Evaluation (IHME), 2014b).

The third consideration was patients' gender, allowing for a 50% proportionate allocation for male and female patients. The study aimed to maintain a balanced representation of both genders in the sample, irrespective of their prevalence in the general population. This strategy was especially beneficial as the research concentrated on conditions or treatments that had similar impacts on each gender. Furthermore, one of the research goals was to evaluate and contrast results across genders. Therefore, having an equal number of records from each gender made this comparison possible.

By implementing a sampling strategy that ensured a 50% representation of each gender, the study sought to minimise potential biases in outcomes and avoid undue influence from any one gender being over or underrepresented. Therefore, the sampling technique ensured that the sample accurately represented both genders. This means that the patients were initially stratified into adult and pediatric patients. This strategy ensured that 288 adults consisting of male (144) and female (144) patient records; and 192 pediatric consisting of male (96) and female (96) patient records were to be sampled from each hospital (refer to Table 3.2).

Simple random sampling

Simple random sampling was used to obtain the number of patient records needed after assessing eligibility for inclusion in the study for each hospital. Simple random sampling is a sampling method in which each item has an equal (non-zero) probability of being selected (Salazar *et al.*, 2006b). For adult records, all records were assigned numbers from 001 to the last number that denoted the total number of records and from 01 to 99 for pediatric records (0-9 years for children

University of Ghana http://ugspace.ug.edu.gh

and for male and female patients respectively). A selection was made for the records using a random table, with each matching selection adjusted for the total number. This continued until the required number of records was obtained. This method has proven useful for gathering information about conditions that may have been missed when using non-random sampling techniques (Vassar & Holzmann, 2013; Worster & Haines, 2004).

Sampling of health worker participants

Targeted criteria sampling was used to select health worker participants for the in-depth interviews (Guest et al., 2006). Guest *et al*. (2006) informed that targeted criteria selection helps to select participants based on research objectives using predetermined criteria. The purpose of a specific criteria selection in this study was to include participants who met a pre-established standard for in-depth follow-up of outcomes derived from quantitative findings on factors related to misdiagnosis (Palinkas *et al*., 2015). Participants for the qualitative interviews were purposively selected. In charges were asked to select clinicians with two or more years of experience within their units to participate in the study. Those individuals were subsequently contacted and invited to participate in the interviews

3.4 Study variables

This section explains how the study variables were defined and measured in the quantitative study. Sub-sections clarify what is meant by the different terms used to discuss the objectives and answer the different research questions.

3.4.1 Dependent variables

The dependent variable was patient misdiagnosis.

University of Ghana http://ugspace.ug.edu.gh

Misdiagnosis: Misdiagnosis is the discrepancy between the initial diagnosis(s) on admission and the final diagnosis (diagnosis on discharge)**.**

Right diagnosis: The patient was considered correctly diagnosed if there was an agreement between the initial (hospitalization) diagnosis(es) and the final (discharge) diagnosis(es).

3.4.2 Independent variables

The independent variables measured in the study were;

a) Patient related factors: age, sex, whether patient was old or new (i.e., being seen for the first time in the month or not), and whether the patient had a comorbidity or not.

b) Disease related factors: The number of morbidities, how common is the diagnosis made, number of presenting complaints recorded.

c) Environmental factors: These included the time and day of admission.

d) Health system related factors: These included service delivery factors such as the hospital of admission, and referral processes.

The independent variables assessed using patient records in the quantitative study have been outlined in Table 3.3.

University of Ghana http://ugspace.ug.edu.gh

Table 3.3: Independent variables

Variable		Description
Patient factors	1. Gender	a) Female b) Male
	2. Age	Continuous data
	3. Type of the patient	a) Old b) New
	4. Patient had an underlying disease (comorbidity) or not	a) Yes b) No
Enviro nmenta l factors	5. The time of admission	a) Day time (7:00 am-4:59 pm) b) Evening (5:00 pm-10:59 pm) c) Night (11:00pm-6:59 am)
	6. The period of the week patient was admitted	a) Weekday b) Weekend
Disease related factors	7. The number of morbidities*	a) One discharge/final disease b) Comorbidity (two discharge/final diagnoses) c) Multimorbidity (3 and more discharge/final diagnoses)
	8. How common is the diagnosis made? *	a) Mixed (patient had both commonly and uncommonly diagnosed diseases) b) Commonly diagnosed disease(es) c) Uncommonly diagnosed disease(es)
	9. Presenting complaints recorded*	a) 1-3 presenting complaints b) More than 3 complaints
Health system related factors	10. Referral status	a) Referred patient from other health facility b) Walk in patient
	11. Hospital	a) H1 b) H2 c) H3 d) H4 e) H5
	12. Patient had investigations (laboratory and radiological) done before admission	a) Yes ………. b) No………..

NB. *Diseases were recorded as written on patient records and later classified as explained using ICD-11.

The factors explored in the qualitative study to explain the findings of the quantitative study have been displayed in Table 3.4.

Table 3.4: A Qualitative Exploration of factors affecting Patient Misdiagnosis within the Health System Building Blocks perspective

Health systems building block	Factors Explored	operationalization of the factors
Service delivery	Service organization and management	Explored how health services are organized and managed, including overall service coordination
	Handling different illnesses	Explored illness management and the adequacy of diagnostic processes.
	Referrals and counter-referrals	Assess the referral systems' effectiveness and their impact on diagnostic processes
	Patient Involvement Initiatives	Evaluate patient participation in diagnosis and care, considering information availability, education, and feedback integration
	Operational support services	Evaluate the effectiveness, availability and the role of key support services like laboratories, radiology and blood banks in ensuring precise diagnostic process.
Leadership and governance	Quality assurance measures	Observed measures and protocols put in place for maintaining and evaluating the quality of the diagnostic services including assessing whether clinical guidelines are adhered to.
	Implementation of healthcare-level policies	Reviewed the existence and use of policies, both national and institutional, that aid diagnosis and prevent diagnostic errors.
	Safety culture	Assessed whether the hospital leadership promotes a culture of patient safety by creating safe diagnosis awareness and educates health workers on best practices to avoid diagnostic errors.
	Organization and structuring of duties	Assess how the hospital leadership organizes duties to ensures diagnostic error prevention including whether they have established clear roles, and fostered effective communication.
	Performance measurement and tracking	Assessed whether the hospital has put in place systems to track diagnostic performance, whether they use data to check success and failure patterns, and whether they utilize this information for targeted improvements and interventions.

INTEGRI PROCEDAMUS

	Incentive systems for diagnostic quality performance.	Established whether the hospital has put incentives in place to promote quality, excellence, and accountability in diagnostics If so, the effectiveness of the systems and their impact on diagnostic performance.
	Support and supervision mechanisms	Assess the support and supervision the hospital leaders provide to health workers involved in the diagnostic processes, including the availability of resources, training opportunities, and mentorship programs to enhance their skills and capabilities in ensuring accurate and timely diagnoses.
	Coordination and governance	Observed the hospital's coordination, governance, communication, decision-making, conflict resolution, and systemic issue handling for diagnostic error reduction.
Human resources for health	Optimal staff placement	Evaluate health workers' training adequacy, focusing on pre-qualification and continuous education and professional development for up-to-date, relevant skills and knowledge in the diagnostic processes.
	Interdisciplinary collaboration	Assess how the collaboration and teamwork among health workers involved in the diagnostic processes affect patient misdiagnosis, focusing on communication, interdisciplinary meetings, and shared decision-making strategies.
	Consultative Practices	Observes how diagnosticians consult peers and specialists for accurate, informed diagnostic decisions and how this has affected patient misdiagnosis.
	Information sharing and intelligence gathering	Observes how the diagnostic teams use digital tools, protocols, and systems for efficient data sharing and collaborative decision-making.
	Continuing education and professional development	Explore the existence, effectiveness and impact if any, of continuing medical education programs for enhancing diagnostic skills of the clinicians involved in the diagnostic processes.
	Staff training and competence in use of diagnostic tools	Evaluate health workers' training, continuous education and professional development for up-to-date, relevant skills and knowledge. competence and proficiency in using the available diagnostic equipment and technologies to accurately diagnosis patients.
	Implementation and Functionality of Health	Investigate whether Health Information Technology (HIT) including Electronic Health Records (EHRs), diagnostic software, and other tools are used to aid

Health information technology	Information Technology (HIT)	diagnostic decisions and if so, the effect of these technologies on occurrence of misdiagnosis in the hospitals.
	Patient information collection and history taking	Assess the role of HIT in history taking (patient information gathering) process, documenting, and accessing complete patient data for accurate diagnostics.
	Information exchange and referral processes	Reviews the processes put in place to use diagnostic information to facilitate information exchange among healthcare providers during referrals, consultations, and collaborative decision-making during the diagnostic processes.
	Existence and use of diagnostic guidelines and protocols	Assess systems put in place to standardize patient information gathering and aiding accurate, timely decisions through adherence to point-of-care guidelines and protocols such as the Uganda Clinical Guideline, and other guidelines
	Diagnostic error tracking and reporting	Established systems put in place to track, report about misdiagnosis and diagnostic errors in general and their role in preventing misdiagnosis of patients.
Medical products, vaccines, and technologies	Availability and functionality of diagnostic equipment	Assess availability, functionality and the impact if any of the diagnostic equipment on the accuracy and speed of diagnoses in the hospitals.
	Challenges in access to medical technologies	Assess how challenges in access to medical diagnostic technologies in the hospitals impact on diagnostic decision making.
Health financing	Resource allocation and availability of healthcare services	Evaluate the effect of the healthcare financing systems (revenue collection, pooling, and resources allocation) on diagnostics processes.
	Influence of payment mechanisms on diagnostic practices	Establish the existing payment methods in the hospitals and investigate their effects on health workers' diagnostic behaviors and patient misdiagnosis.
	Financial implications on patient decision-making	Assess the effect of costs of tests on patients' diagnostic decision-making and the subsequent impact on the diagnostic process and patient outcomes.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

3.5 Data collection

This section explains how data was collected using both documentary review and qualitative data methods. Data were collected through a retrospective review of records of patients admitted to the selected hospitals for a 12-month period starting from 1st July, 2019 to 30th June, 2020; and health workers. The records review provided data for quantitative analysis, and qualitative data were generated from in-depth interviews with physicians and medical officials, as shown below.

3.5.1 Quantitative Data Collection (Records review)

Data were extracted using the Open Data Kit (ODK) mobile app and stored directly on an Android tablet, then exported as an Excel spreadsheet. The records reviewed included patients admitted to pediatric and medical wards through outpatient and emergency departments (OPD and ED) from July 1, 2019, to June 30, 2020. This period was considered long enough to accommodate variations in physician diagnostic practice and disease profiles at the study hospitals.

Data mining for record-based data mining follows previous researchers' guidelines (Worster & Haines, 2004). The data comes from the Health Management Information System (HMIS) form 51 (Hospital Treatment Form), the Hospital Discharge Form (HMIS Form 052), and the Hospital Discharge Register (HMIS Form 054) (Ministry of Health, 2010). Copies of these HMIS forms are attached as Appendices E to G.

Form HMIS 051 (Appendix F) contains the treatment record of admitted patients. It includes the patient's name, admission date, inpatient number, age, gender, admission time, referral status, admission diagnosis, and review notes. HMIS Form 052 (Appendix G) is the discharge form on which the final (discharge) diagnosis is written. In addition to patient demographics, it also includes information about clinical presentation and discharge status. HMIS Form 054 (Appendix

University of Ghana http://ugspace.ug.edu.gh

H) is the inpatient register. It contains 14 variables that summarize the two forms above. It contains all the information about the patient and everything that happened during the hospital stay. The explanations of these variables can be viewed and read in the forms. The data extraction form is designed to follow the hospital admission form and treatment card format. Appropriate categories were created for each variable to facilitate data extraction and minimize data loss and the possibility of collecting data in the wrong category (Please see the data extraction sheet in Appendix C).

In order to ensure the anonymity of patients' records, no personal information such as names, addresses, or phone numbers were recorded. Strict access controls and protocols were implemented to ensure that only the researcher and the research assistants had access to or could handle the records. After the daily data extraction, the records were immediately returned to storage to prevent unauthorized access by any third parties. A unique identifier or code was assigned to each patient, which bore no relation to the actual patient. After verifying the eligibility of all sampled records, data abstraction was performed by four research assistants working with the researcher. Whenever the research assistants encountered difficulties, they spoke to the researcher for clarity. If the researcher could not clarify a question, a clinician at the outpatient clinic was called to clarify. Data were collected in hospital boardrooms adjacent to records departments to prevent moving them around and allowing non-research team members to access the patient records. Generally, the data extraction form was designed to capture data on the key variables assessed in the quantitative study as explained below.

University of Ghana http://ugspace.ug.edu.gh

Data collection to obtain misdiagnosis

Data extraction was conducted explicitly based on the recommendation of the National Academy of Medicine (NAM, 2015). The discharge diagnosis was considered the reference diagnosis. The diagnosis on admission at the outpatient or emergency departments and the diagnosis at discharge (final) as recorded in the chart were compared. The patient's diagnosis status was noted as "misdiagnosed" or "correctly diagnosed" (not misdiagnosed). The diagnostic discrepancy is the trigger tool that determines who was misdiagnosed and who was correctly diagnosed (NAM, 2015).

The choice to use discrepancies between admission and discharge diagnosis to investigate misdiagnosis was based on previous studies on the same topic (Abe *et al*., 2019; Fatima *et al*., 2021; Hautz *et al*., 2016; Kijima *et al*., 2018a). Hautz *et al*. (2016) conducted a study of the diagnostic discrepancy between the emergency department and the admissions department. These researchers inferred that the diagnostic discrepancy pointed to a misdiagnosis. Kijima *et al*. (2018) used this approach in Japan to study the diagnostic accuracy of elderly patients with acute illnesses seen in a primary care centre and were subsequently admitted to an emergency hospital department within a four-day period.

Prior studies have demonstrated that differences between admission and discharge diagnoses can serve as a dependable indicator for identifying patient misdiagnoses. Avelino-Silva and Alan (2020) identified diagnostic discrepancies between hospitalisation and discharge diagnoses among elderly patients and asserted that while not all changes in diagnoses were due to errors, a large proportion of the discrepancies were due to misdiagnosis in Sao Paul Brazil. A study in Japan,

University of Ghana http://ugspace.ug.edu.gh

examined infection site misdiagnosis by comparing the discrepancies between the original infection site and the one assigned in the final diagnosis (Abe *et al*., 2019). Therefore, in this study, inaccuracies between the initial and final diagnosis were considered misdiagnoses based on the above studies.

Categorisation of misdiagnosed diseases

The 80/20 (Pareto Principle or rule) was used to categorize the patient's conditions as either common illnesses or uncommon illnesses. The common illnesses were the 20% of the diagnoses (diseases) responsible for 80% of the final diagnoses. This means that a small proportion of common diseases dominated most cases (common diseases). These commonly diagnosed diseases (diseases that constitute 80% of the final diagnoses in the hospital) with their proportion in all the diagnoses recorded included: malaria (48.4%), pneumonia (6.6%), severe anemia (3.7%), peptic ulcer disease (3.6%), gastroenteritis (3.3%), bacteremia (2.3%), urinary tract infection (2.2%), respiratory tract infection (1.9%), sepsis (1.9%), hypertension (1.5%), enteric fever (1.2%), sickle cell disease with crisis (1%), diabetes mellitus (0.9%), acute malnutrition (0.9 %), and bacterial infection (0.9%). The 80% of diseases that were identified 20% of the time were considered uncommon diseases. Patients who were diagnosed with both common and uncommon diseases or illnesses fell into a mixed categorization.

Data collection of patient related factors

The data retrieved included demographics such as age and gender, as well as information about the clinical admissions process, including medical history (whether the patient was new or old) and whether the patient had an underlying disease or condition. A new patient was a person who

University of Ghana http://ugspace.ug.edu.gh

presented for the first time in a period of the month preceding the then admission or who had been seen on an outpatient basis during the same one-month period. An "old patient" refers to an individual who has either received outpatient treatment or had another admission to the same hospital within a month prior to the current admission under review. The independent variables (predictors) of misdiagnoses were based on the functionalised factors shown in Table 3.3.

Data collection of disease related factors

More information was gathered about the disease's clinical characteristics, such as signs and symptoms, the number of diagnoses made at the time of admission, the type of illness, and the number of presenting symptoms, as well as information about imaging and laboratory results and the medical care received. A classification based on morbidities was created based on how many diseases the patient had. Having three or more final diagnoses was called "multimorbidity". Comorbidity is the presence of two discharge diagnoses in a patient. Once there was only one final discharge assigned, the patient was labeled as having one disease.

Data collection of environmental (contextual) factors

Time-related factors included the time of day and the day of the week. As part of the review, the days of the week were extracted from the records and classified into weekdays (Monday through Friday) and weekends (Saturday and Sunday). Furthermore, contextual factors included whether the patient had been referred from a lower-level health facility or not.

University of Ghana http://ugspace.ug.edu.gh

3.5.2 Qualitative data collection (in-depth interviews)

The qualitative data collection phase followed the quantitative data analysis phase (based on the explanatory sequential mixed method applied). The National Academy of Medicine (2015) pronounces that in-depth interviews are vital for obtaining information about diagnostic errors. Creswell (2014) articulates that a qualitative in-depth interviewing approach necessitates meticulous cross-examination of participants to elicit their perspectives on a particular issue, programme, or circumstance. To better understand how factors related to patient misdiagnosis were perceived in this study, in-depth interviews with health workers involved in the diagnosis process were conducted. Interviewing frontline healthcare workers who are at the heart of the diagnostic process is also considered a novel approach to understanding the complexities involved in the diagnostic process and why diagnosis sometimes gets wrong (Schiff *et al*., 2005).

Specifically, in-depth interviews with health workers involved in the diagnostic process provided cognitive insights into human and ergonomic factors that could predispose them to error (NAM, 2015). Additionally, Mcnair *et al*. (2008) emphasised that the use of in-depth interviewing techniques in primary healthcare research enables researchers to better understand the patient-clinician relationship and the healthcare experience. Zwaan *et al*. (2013c) note that in-depth interviews aid clinical researchers in reflecting on their identities as health workers. They can therefore, use these experiences to their advantage to get past any hesitations such researchers may have about conducting interviews.

Health workers were divided into two groups. Clinical officers, who perform the first diagnosis in outpatient and emergency rooms, comprised the first category. At least three clinical officers from

University of Ghana http://ugspace.ug.edu.gh

each hospital were earmarked for interviewing. The second category consisted of medical officers who review admitted patients in the wards. The medical officers are thought to have more advanced diagnostic expertise than clinicians due to their training. They provided crucial perspectives relevant to the interface with the patients they reviewed. Two medical officers were initially targeted for interviewing from each hospital. In the nutshell, there were two categories of health workers involved in diagnostic procedures; the clinical officers make the preliminary (admission) diagnoses in the outpatient or emergency room, and the medical officers examine the admitted patients in the ward to make the definitive diagnosis in the Ugandan health care system (National Academy of Medicine (NAM), 2015).

Fifteen (15) health workers, including eight clinicians and seven medical officers, participated in the in-depth interviews (IDIs) to explore reasons patients receive incorrect diagnoses and the factors that could contribute to their occurrence. This was based on saturation after subsequent interviews yielded no new information.

Semi-structured interview guide

The interviews were conducted with the use of a semi-structured guide/in-depth interview guide. By using this tool, the interviewer had more freedom to ask clarification-seeking questions on specific topics mentioned by respondents, a tactic known as probing (Richards & Schwartz, 2002). The semi-structured interview guide was set within a framework to answer the following question: What is the perception of patient misdiagnosis among health workers in general hospitals in Central Uganda?

University of Ghana http://ugspace.ug.edu.gh

The semi-structured interviews were conducted to learn more about health professionals' perceptions of the magnitude of the misdiagnosis problem in the hospital where they worked. They shared their opinions on the possible factors they believed were generally responsible for patients' misdiagnoses in the emergency and outpatient departments. The health system building blocks were discussed along the lines of misdiagnosis.

Based on data saturation, the target was to interview five respondents from each hospital. However, saturation was established following interviews with twelve participants, including six clinicians and six medical officers, from four hospitals: H1, H2, H3, and H4. However, at the fifth hospital, three additional interviews were conducted (H5). The participants' permission was obtained before the researcher began the interviews. The researcher used a tape recorder/digital voice recorder to record the interviews. These face-to-face (IDIs), which lasted between 19 and 40 minutes, were conducted in hospital board rooms when the medical staff was off duty to avoid interfering with patient care (see Appendix D for the semi-structured interview guide).

3.6 Quality assurance

Different quality control /assurance measures were applied in this study for the two data collection procedures employed as explained below.

Validity

One pediatrician, one doctor, and a specialist in healthcare quality evaluated the data abstraction checklist for face and content validity (Lam *et al*., 2018). Kimberlin and Winterstein (2008) explained that a research tool or item developed by experts in a particular field of study or practice

University of Ghana http://ugspace.ug.edu.gh

is evaluated for its "content validity". Experts evaluate the various constructs under investigation to make sure the elements or criteria selected to study a particular subject are appropriate throughout this process (Banks, 1998). The experts evaluated whether all relevant information about the diagnosis status could be fully extracted from medical records using the designed data extraction form. The experts also determined whether the potential for misdiagnosis was related to any of the listed variables. If the experts were pleased with the variable, they gave it a score of 1, and if not, they gave it a score of 0. This was done for each question on the form as seen in the data extraction form in Appendix C.

An expert must review the items in the questionnaire or extraction form to determine whether the questions posed, or the items sought are an accurate predictor of the concept being measured (Bhattacharyya *et al*., 2017). This was done to ensure that the constructs and format being proposed for the data collection in this research were appropriate for the records used in the management of admitted patients in hospitals in Uganda. Two records assistants with prior experience in record data extraction tested the data extraction form At Kiboga Hospital, on a month's worth of patient records from August 2018. This determined whether the data written in the various HMIS forms (source documents) could be extracted using the data extraction form. The record assistants independently examined 60 similar forms to determine whether the variables relating to disease diagnosis had been completely covered in the data extraction forms and the source documents. Then, any inconsistencies or confusing information from the abstraction form and the patient records was identified and corrected.

University of Ghana http://ugspace.ug.edu.gh

Reliability

The reliability of research tools was another subject of the quality assurance measure. The reliability of research tools is the degree to which a review tool, questionnaire, test, or other measurement used produces consistent results when used repeatedly. The tools' reliability was examined during pre-testing using the Kappa statistic, which has a range of 0 to 1. As previously stated, a score closer to 0 indicated less reliability, while a score closer to 1 indicated perfect reliability (Mchugh, 2012). This test accounts for any coincidental agreement between reviewers. In this study, 60 similar records were given to the reviewers, who each independently extracted data on 15 different variables. The consistency of their reviews was examined and interpreted in accordance with accepted literature guidelines (Mchugh, 2012). The agreement between their reviews was tested and interpreted according to standard recommendations in literature. In the event where the inter-coder agreement was below 0.8, reviewers revised and harmonised the tools to enhance the reliability of the research tools as suggested (Salazar *et al*., 2015).

Training of the research assistants

Research assistants received two days of practical training in data handling and extraction. The training was held at Kiboga Hospital and the tools were tested thereafter. The study hypothesis and research questions were kept secret from data extractors throughout the training and research processes. This was done to avoid the extractors' bias in favour of including or excluding some particular information from the records. Explanatory variable definitions and inclusion and exclusion criteria were also established to aid data extractors in quickly locating the right records from which to extract data. Mack *et al*. (2018) acknowledged that one of the problems affecting the quality of observational studies based on records data is missing data. Mack *et al*. (2018)

University of Ghana http://ugspace.ug.edu.gh

recommended some measures to prevent and handle missing data when using patients' records, which were adopted and used in this research. These included, among others; picking variables that were reflected in the records used in the hospital.

Pre-testing

Prior to rolling out the full study, pre-testing of the research tools was conducted to identify any variables that might be missing. It was based on this that data originally planned to be extracted about the diagnosticians was dropped from the variables. Out of the 100 records used for pre-testing, it was established that only 21/100 (21%) of the records had the clinicians appending their signature on the patient admission form. It was based on this that the variables such as clinician gender, experience, and age were dropped. Out of the remaining 79 records, one was later excluded for poor handwriting and unreadability. The data extractors were informed during training that the quality of their work was to be checked for accuracy. Continuous data review for completeness, quality, and accuracy was conducted by the researcher to ensure that all data collected met the standard.

3. 7 Data management and analysis

This section presents how the data collected were managed and analysed to arrive at the findings of the study.

3. 7. 1 Quantitative data analysis

This section presents the methods employed to analyse and validate the data. In the analysis of the collected data in this study, the quantitative component was given a higher priority. The research assistants' privileges were only limited to entering and sending data to the main server as pointed

University of Ghana http://ugspace.ug.edu.gh

out (Harvey, 2018). Only the researcher and the administrator of the server had administrative rights, including data export and were able to view data from other hospitals. Two stages of data cleaning were employed to ascertain any inconsistencies, outliers, and errors with the data. Data was exported into an excel spreadsheet where it was cleaned to ascertain that all variables of interest had been collected in the Open Data Kit (ODK) software. Any errors and inconsistencies detected were corrected in the ODK. After this, the data was coded and entered into the computer using the IBM statistical package for social sciences (SPSS) version 25 where further data cleaning was conducted, including checking for accuracy, missing information and completeness, displaying and data transformation. The data was later exported to StataIC version 15.0 (Stata Corporation, College Station, TX, USA) where analysis was conducted. Descriptive characteristics of the categorical variables were summarised as frequencies and proportions and presented as tables, pie and pareto charts depending on the characteristic of interest.

Prevalence of misdiagnosis

In this study, a patient was considered to have been either misdiagnosed or correctly diagnosed. A patient who was rightly diagnosed (No - variable of interest is present) was coded 0 while one who was misdiagnosed (Yes - variable of interest) was coded 1 because by default, STATA defines 0 as the absence of the variable of interest. The prevalence of misdiagnosis was established by dividing the sum of misdiagnosed patient records by the total number of patient records reviewed in the study period. This was done for all the hospitals and for each specific hospital (i.e., proportion of number of misdiagnosed patients as per the records reviewed at a specific hospital).

University of Ghana http://ugspace.ug.edu.gh

Classification of misdiagnosis

To classify misdiagnosis, this study made use of the International Classification of Diseases (ICD-11) 11th revision (WHO, 2017). Previous studies had used the ICD to analyse disease diagnosis (Johnson, 2009; Ordi *et al*., 2009; Polder & Achterberg, 2004; Polder, 2001). The ICD-11 groups all diseases, health related conditions, causes of illnesses or death into 26 disease groups and two supplemental groups (WHO, 2017). The ICD-11 system's classification is structured into three levels. The first level is the major diagnostic grouping. This is the highest level of classification, comprising 26 classifications and two supplemental classes. The ICD-11 arranges diseases and disorders based on factors such as their causes, anatomical location, or severity. These are also called chapters (WHO, 2017).

The second level in the ICD-11 classification is the parent grouping. This level classifies diseases and disorders by their clinical manifestations, pathogenesis, or therapeutic similarities. Within each of the major grouping, there are several parent groupings. The parent grouping may have a primary parent grouping and secondary parent grouping. The parent category is the main category within the major group where the disease may fall. The secondary category on the other hand is a subcategory within a primary parent category (WHO, 2017). Lastly, the third level in the ICD-11 classification signifies individual (specific) disease conditions. This level includes more than 80,000 individual disease conditions that have been coded within the system (WHO, 2017).

During the records review, both admission and discharge diagnoses were recorded as written by the health workers and the ICD codes assigned by the researcher using the digit numbers that took into consideration the major diagnostic grouping, parent grouping and the individual disease condition. Guided by the International Classification of Diseases grouping typology and effect of

University of Ghana http://ugspace.ug.edu.gh

the correction of the diagnosis on the treatment was prescribed depending on the agreement or disagreement between the initial diagnosis and the final diagnosis. Misdiagnosis was thus, classified as Class I, Class II serious, Class III, and Class IV. The ICD-11 classifications are highlighted in Appendix E and explained in Table 3.4.

Table 3.5: Classification of misdiagnosis using ICD-11

Classification	Description of the misdiagnosis
CLASS I	A condition where the initial and final diagnoses belong to different major diagnostic grouping so that the change of diagnosis necessitates changing the treatment initially prescribed at admission. An example of such misdiagnosis may be diagnosing a patient with *Rheumatoid Arthritis* (Diseases of the musculoskeletal system or connective tissue) as *Bacteremia* (Diseases of the blood or blood forming organs).
CLASS II	The initial and final diagnoses are in the same major ICD-11 grouping but they belong to different parent grouping. This change may necessitate major treatment changes. For example, a patient initially diagnosed as having *Severe malaria* but diagnosis changed to *Enteric fever (Typhoid)* after being reviewed hence necessitating treatment change. Both diseases belong to the major classification of "Certain infectious or parasitic diseases" but have different parent classifications of "Malaria" and "Bacterial intestinal infections" which necessitate 75%treatment change of more than.
CLASS III	This is the classification where; the initial and final diagnoses belong to different major diagnostic grouping or they are in the same major diagnostic grouping but different parent grouping. However, the change of diagnosis may not necessitate more than 25% of change in the treatment originally prescribed. For example, where the initial diagnosis was major classification of "Certain infectious or parasitic diseases" but the final/discharge diagnosis is "Diseases of the respiratory system" but no treatment changes occurred. • *Initial (wrong) diagnosis Streptococcal pharyngitis (01 major diagnostic grouping) final (right) diagnosis pneumonia (12 major diagnostic grouping)* • *Initial (wrong) diagnosis (enteric fever) (1A07 parent classification) final (right) diagnosis bacteremia (MA15 parent classification)*
CLASS IV	The initial and final diagnosis are in the same major and parent ICD-11 grouping but there is a difference in the final codes whose change in diagnosis may not necessarily require changing the treatment initially prescribed. Such a misdiagnosis may have examples of say diagnosing gastritis as peptic ulcer disease.

Establishing the most misdiagnosed major disease diagnostic groupings and topmost misdiagnosed diseases

When there are many causes to the problem, there is a possibility for having an awkward zone where there is no clear break point between the vital few and trivial (useful) many is unclear. When

University of Ghana http://ugspace.ug.edu.gh

prioritising the problems for improvement, there is a need to concentrate on the problems with the highest frequencies (Britz et *al.,* 1997). This helps not to be preoccupied by problems appearing singly since in their individual capacity they may not provide the greatest benefit if much efforts are placed in addressing them (Taylor, 2010). It is upon this background that prioritisation was made of the major diagnostic groupings where misdiagnosis occurs, the topmost misdiagnosed conditions or diseases in each of the top most major diagnostic groupings and the overall top most misdiagnosed conditions.

The most misdiagnosed major diagnostic groupings: Pareto Principal classification

This study employed the Pareto Principal classification to identify the critical minority of major diagnostic groupings where the majority (80%) of misdiagnosed cases in the hospitals under investigation are. This analysis is graphically represented in the Pareto curve (Picarillo, 2018). To achieve this, all misdiagnosed conditions were categorised into their respective major diagnostic groupings, and the total frequency of misdiagnosis within each group was determined. The major diagnostic groupings were then arranged in descending order of frequency, and a cumulative frequency was calculated. A Pareto chart was subsequently constructed to visualise the threshold at which the top 20% of major diagnostic groupings contributed to 80% of the misdiagnoses. This methodology enabled the identification of the most critical disease categories responsible for the majority of misdiagnoses, providing valuable insights for targeted quality improvement initiatives.

The most misdiagnosed diseases among the topmost misdiagnosed major diagnostic groupings

A further analysis was made to establish the top misdiagnosed conditions or diseases for each of the topmost misdiagnosed major diagnostic groupings. To obtain this, the proportion of the leading

University of Ghana http://ugspace.ug.edu.gh

misdiagnosed conditions in each of the major diagnostic groupings was established. All the other diseases within the major diagnostic groupings were categorised as “others”. These were thereafter presented in a graph.

The top- most overall most misdiagnosed conditions or diseases

The Pareto principal was also used to establish the 20% of the diseases or conditions that made up the 80% of the top misdiagnosed diseases in the hospitals studied. The same procedures were used as earlier described though in this case, the analysis was done with all conditions or diseases that had been misdiagnosed more than once. Out of the 303 total misdiagnoses, there were 123 conditions or diseases involved. From these, 34 of the 303 total misdiagnoses had been misdiagnosed more than once contributing to 74% of all the misdiagnosed conditions. Based on the declaration by earlier researchers, the 34 diseases that were misdiagnosed more than once were the ones considered in the drawing of the Pareto curve to determine the topmost misdiagnosed conditions that the hospitals need to be cognizant of when prioritising diseases for diagnostic improvement (Britz et *al.*, 1997; Taylor, 2010). However, in the prioritisation of the diseases to be considered for attention, the 89 diseases/conditions were kept in mind among the trivial (useful) many.

Logistic regression analysis to establish factors associated with misdiagnosis

Logistic regression is a predictive analysis that can be used to describe data and to explain the relationship between the dependent binary outcome variable with other independent variables (Sperandei, 2014). It was preferred for use in this analysis since the dependent variable was

University of Ghana http://ugspace.ug.edu.gh

dichotomous (binary) with the fact that modelling was to be conducted to establish the factors associated with patient misdiagnosis.

The bivariate logistic regression analysis was used to describe and determine the individual factors associated with patient misdiagnosis without accounting for other factors. Each of the independent categorical variable was independently regressed with the dependent categorical variable (misdiagnosis). The factors that were significantly associated with patient misdiagnosis at bivariate analysis with $P<0.1$ were considered for inclusion in the multivariable logistic regression analysis model (Park, 2013). The unadjusted odds ratios (uOR) of the significant factors associated with misdiagnosis at bivariate analysis were reported with their corresponding p-value and 95% confidence interval (95% CI).

To come up with the final multivariable regression model, one variable was first considered and then others serially added to the model. At each level, the likelihood ratio test for nested models was used to demonstrate that the current model with added variables was a better fit than the previous model with fewer variables (Klein & Moeschberger, 1997). Finally, the manually constructed model was compared against the automatically constructed models by forward selection and backward elimination using the Akaike's information criterion and Bayesian information criterion (Kohler & Frauke, 2012). The manual model was still a better fit and was therefore, considered as the final model of best fit to determine factors that were independently associated with misdiagnosis. The adjusted odds ratios (aOR) of the significant factors associated with misdiagnosis were reported with their corresponding p-value and 95% confidence interval (95% CI).

University of Ghana http://ugspace.ug.edu.gh

3. 7. 2 Qualitative data analysis

To clean the data as well as getting embedded into the data at an early stage, transcription of the data was conducted by the researcher. The early embedment into the data helped the researcher to establish early emerging themes. The qualitative data was analysed using the deductive thematic data analysis technique (Braun & Clarke, 2006). The choice of thematic analysis for this study was made against the assertion that this method works well for research premised on the realism epistemology (Braun & Clarke, 2006). Thematic analysis extracts experiences, meanings and the reality that participants attach to a phenomenon. The choice of the thematic analysis method was pertinent since this was an explanatory method where health workers were interviewed to give their experiences, and meanings to the misdiagnosis phenomenon (Braun & Clarke, 2006). Deductive thematic analysis takes the top-down approach. Predetermined codes are developed and excerpts that fit particular codes are obtained to be attached to the codes (Creswell, 2007b, 2007a; Creswell & Poth, 2018; Tracy, 2013). The codes in this research were developed immediately after the quantitative data analysis along the health system building blocks (WHO, 2007, 2017).

The qualitative data analysis necessitated paying particular attention to explanations of the findings that had been obtained from the quantitative findings, originally carried out in the first phase. The analysis commenced with data transcription, which included having to listen to all the recorded data audios, subsequently, getting acquainted with the data, and appraising the captured notes to correct any inconsistencies that arose. The transcripts were transferred to the excel sheet where manual data analysis was undertaken. Quotations that expressed the main message within a category were selected and used to strengthen up the idea being presented. In the presentation of

University of Ghana http://ugspace.ug.edu.gh

the results, the clinicians have been coded CO1-CO8 (CO means Clinical Officer) while the Medical Officers have been coded as MO1-MO7 (doctor 1 to doctor 7). Integration of the qualitative and quantitative data was exhibited by way of the qualitative information giving explanation to the quantitative findings in the results section of the study.

3.8 Ethical considerations

The researcher followed all the required ethical issues expected of a study of this nature as presented below.

Ethical clearance

The researcher abided by the ethical principles laid down by the Uganda National Council for Science and Technology (UNCST) for any research that has humans as research participants as well as the policy and guidelines for registration of PhD studies (UNCST, 2014, 2016). These principles included non-maleficence (ensuring that the research does no harm to participants), beneficence (ensuring that any risks related to the research are reasonably justified by the benefits that come with the research). Beneficence also calls for engaging competent researchers who can apply ethical research values. The principle of justice requires that the researcher treats participants according to what is considered morally apposite. On the other hand, respect for persons (autonomy for those who are able to deliberate their choices in participation of the research as well as to those who are impaired or those whose participation is dependent on others) was adhered to.

To ensure that the research meets the above principles, the letter of introduction was issued by the Department of Health Policy, Planning and Management, School of Public Health, College of Health Sciences, University of Ghana with reference number: HP/AC.12/1/2017, and ethical approval was obtained from the Mildmay Uganda Research and Ethics Committee (MUREC) with reference number: REC REF 0505-2020 and the Uganda National Council of Science and

University of Ghana http://ugspace.ug.edu.gh

Technology with reference number: HS826ES**.** The ethical approval forms from the Institutional Review Board (Appendix J) and the letter of approval to conduct the study from UNCST (Appendix K) are attached as appendices.

Permission from the study sites

Permission to conduct the study in each of the hospitals was granted by the medical superintendents who introduced the researcher and the research team to the ward in-charges and the various offices /departments from where the data was collected. The letters of ethical approval by MUREC, the UNCST and the permission letter from the University of Ghana sanctioning the study were presented to the medical superintendents.

Confidentiality and anonymity

To ensure confidentiality and anonymity of the patients' records, the data was extracted incognito by not placing personal identifiers on the data extraction form neither was such information used in the data analysis nor report writing. Patients' information that was not disclosed included; patient's name, occupation and address. The patient's admission number was however, used for the purpose of easy retrieval should the need to refer to a specific record arise/arose. The data is also presented in such a way that information pertinent to a patient cannot be disclosed. No patient's records were taken out of the hospital, and neither was any photograph of a patient's records taken. While collecting qualitative data, confidentiality was ensured by seeking permission from the health workers to record and take notes from the interviews. The reason as to why the interviews were recorded was explained to the participants. Participants were also informed that their responses were to be kept confidential and none of their names or places of work or any hint that would help the reader trace the respondent was to be used in the writing of the report.

University of Ghana http://ugspace.ug.edu.gh

Permission was sought from the health workers to use abstracts from the interviews as quotations. To maintain anonymity, the hospitals in Kiboga, Nakaseke, Mityana, Gombe, and Kayunga have been assigned the pseudonyms H1, H2, H3, H4, and H5, respectively.

Voluntary withdrawal

At any time during the interviews, a participant was allowed to withdraw from the research even though they had already consented to participate. All the data collected from such a participant was discarded altogether and not used in the analysis. However, none of the participants opted out of the interviews.

Participants' consent

Since data was obtained from medical records, no individual patient's consent was sought to access their records. Besides, it was deemed that access to such information being sought in relation to the study objectives even without the knowledge of the patient was not to harm the patient. All information to be included in the informed consent form as stipulated by the UNCST was provided (UNCST, 2014). The researcher ensured that the participants in the in-depth interviews fully understood the information provided in the informed consent form pertaining to the study and its implications. The participant's consent form is shown in Appendix B.

Data storage and usage

All the transcripts were stored in the researcher's computer, which was password protected. Only the researcher had access to the password protected laptop and digital tablet where the interviews, notes and transcripts were stored. The same was true of the checklists and data extraction forms and the data from the semi structured interviews. Data was not shared with any individual or organisations.

University of Ghana http://ugspace.ug.edu.gh

Compensation

No monetary compensation was made to any participant in this research.

Conflict of interest

Regarding conflict of interest, the researcher declares that this research was not influenced by any other external factors, hence, it was free of any research interests.

Risks and benefits

This research posed no physical and psychological harm to participants or patients. Data from the records reviewed were well protected as explained that no patients' information would be revealed to create any opportunity of invasion of privacy.

Protocol amendments

The guideline laid down by the UNCST (2016) on the amendment of the research protocol was adhered to. With this, should there had been any amendments or adjustments to the protocol, research instruments or even to the consent form, this amendment were to first be communicated to Mildmay Uganda Research and Ethics Committee (MUREC). Thereafter, the UNCST was to only be notified of the changes by MUREC within a period of ten working days.

Funding

There was no third-party funding for this research as all costs were met by the researcher.

3.9. Chapter Summary

This chapter has detailed the procedures used to conduct this study with justifications of the approaches suggested in relationship to the research objectives and research questions. A sequential explanatory mixed method was thus, suggested describing in detail the methods of data

University of Ghana http://ugspace.ug.edu.gh

collection and analysis. First, a quantitative approach was used to establish the prevalence of misdiagnosis, classification of misdiagnosis, determining the conditions commonly misdiagnosed through a Pareto principal analysis and logistic regression analysis to determine the factors associated with patient misdiagnosis. In the second phase of data collection, in-depth interviews were conducted with the frontline clinicians who diagnosed patients and medical officers who reviewed the admitted patients to confirm or ascertain the diagnoses made to gain richer insights into the factors responsible for occurrence of misdiagnosis. With this methodology, chapter four presents, explains and interprets the results of each of the phases of this mixed method research.

University of Ghana http://ugspace.ug.edu.gh

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents findings of the study conducted to establish the burden of misdiagnosis and associated factors among hospitalized patients. The results are presented in two separate sections: quantitative and qualitative results. The section on the quantitative results is presented in line with the following themes: the proportion of misdiagnosis among patients, classification of misdiagnosis, and disease conditions that are commonly misdiagnosed. The other results are presented under the major theme of factors associated with patient misdiagnosis and sub-themes of; patient related factors and patient misdiagnosis where factors such as; age, sex, type of patient are discussed.

The section on the qualitative results is presented on sub-themes under factors associated with misdiagnosis which included health system related factors and patient misdiagnosis, including governance and leadership, service delivery, medical supplies and procurement, information, communication and technology, health financing and health human resources. The chapter ends with a summary where the main achievements are presented as well as the indication of what is contained in the next chapter presented.

4.2 Quantitative results

As indicated earlier, this section on the quantitative results is presented in line with the following themes; the proportion of misdiagnosis among patients, classification of misdiagnosis, and disease conditions that are commonly misdiagnosed. The other results are presented under the major theme of factors associated with patient misdiagnosis and sub-themes of; patient related factors and patient misdiagnosis where factors such as; age, sex, type of patient are discussed.

University of Ghana http://ugspace.ug.edu.gh

4.2.1 Characteristics of the Patients' Records reviewed

The results showed that the proportion of patients' records reviewed from each of the five hospitals were almost identical. Of the 2431 patient records reviewed, it was found that 1003 (41.3% [95% CI: ±3]) were children within the age range 0-9 years. The records showed a higher number of female patients 1262 (51.9% [95% CI: ±2.8]) compared to male patients 1169 (48.1% [95% CI: ±2.9]). The results showed that a significant proportion, 95% [95% CI: ±0.9] of patients were admitted directly without referrals from lower-level health facilities. The majority of these patients, 2341 (96.3%), were new cases and were visiting the hospital for the first time within the month before their admission. Before being admitted, 2041 (84%) of these patients had undergone some form of investigation, either laboratory or radiology or both, prior to their initial diagnosis.

Upon admission, the majority of patients, 2,114 (87%, [95% CI: ±1.4]) reported three or fewer symptoms. When it comes to pre-existing conditions, a significant number of patients, 2,055 (84.5%, [95% CI: ±1.6]) had no known underlying medical conditions on admission day. Out of the total 2,431 patients, 1,991 (81.9%, [95% CI: ±1.7]) received a single disease diagnosis as their final diagnosis. A substantial number of patients, 2,076 (85.4%, [95% CI: ±1.5]) were admitted during the day. Furthermore, 1,976 patients (81.4%, [95% CI: ±1.7]) were admitted on weekdays from Monday to Friday. Lastly, about 1,861 patients (76.6%, [95% CI: ±1.9]) received a final diagnosis that was classified as only common disease. Table 4.1 presents an overview of the characteristics of patients' records reviewed.

University of Ghana http://ugspace.ug.edu.gh

Table 4.1: Characteristics of the patients' records reviewed (N=2431)

Variable		Frequency Number (f)	Percentage (%)	95% CI
Hospital (N=2431)	H1	481	19.8	±3.6
	H2	489	20.1	±3.6
	H3	485	20.0	±3.6
	H4	489	20.1	±3.6
	H5	487	20.0	±3.6
Age category (N=2431)	0-9	1003	41.3	±3.0
	10 to 19	408	16.8	±3.6
	20-29	315	13.0	±3.7
	30-39	199	8.2	±3.8
	40-49	141	5.8	±3.9
	50 and above	365	15	±3.7
Gender	Female	1262	51.9	±2.8
	Male	1169	48.1	±2.9
Referral status of the patient	Referred	131	5.4	±3.9
	Not referred	2,300	94.6	±0.9
Type of patient	Old patient	90	3.7	±3.9
	New patient	2341	96.3	±0.8
Initial diagnosis made after investigations	No	390	16.0	±3.6
	Yes	2041	84.0	±1.5
Number of presenting complaints	More than 3	317	13.0	±3.7
	1-3	2,114	87.0	±1.4
Presence of underlying health condition	Yes	376	15.5	±3.7
	No	2055	84.5	±1.6
The number of morbidities	One disease	1991	81.9	±1.7
	Comorbidity (2 final diagnoses)	390	16.0	±3.6
	Multimorbidity (3 or more final diagnoses)	50	2.1	±4
Time of admission	Day time	2,076	85.4	±1.5
	Evening	223	9.2	±3.8
	Night	132	5.4	±3.9
Period of the week patient was admitted	Weekday	1976	81.3	±1.7
	Weekend	455	18.7	±3.6
How common is the diagnosis made	Combination of common and uncommon disease	144	5.9	±3.8
	Only common disease	1861	76.6	±1.9
	Only uncommon disease	426	17.5	±3.6
Diagnostic status	Not misdiagnosed	2208	90.8	±1.2
	Misdiagnosed	223	9.2	±3.8

University of Ghana http://ugspace.ug.edu.gh

4.2.2 Prevalence of misdiagnosis

Upon reviewing the records of 2431 patients, it was found that 223 patients (9.2%, [95% CI: ±1.2%]) patients had been misdiagnosed. Nonetheless, the prevalence of misdiagnosis varied, with H2 recording the highest rate of misdiagnosis at 62 out of 489 cases in the hospital (12.7% [95% CI: ±3%]). The misdiagnosis in H2 accounted for 62 out of the 223 (27.8% [95% CI: ±5.9]) misdiagnoses in all the hospitals combined. Table 4.2 shows results of prevalence of misdiagnosis.

Table 4.2: Prevalence of misdiagnosis

Hospital	Frequency Number	Within the hospital		Within all the hospitals	
		Percentage	95% CI	Percentage	95% CI
H1 (n=481)	32	6.7	±2.2	14.4	±4.6
H2 (n=489)	62	12.7	±3.0	27.8	±5.9
H3 (n=485)	51	10.5	±2.7	22.9	±5.5
H4 (n=489)	44	9.0	±2.5	19.7	±5.2
H5 (n=487)	34	7.0	±2.3	15.2	±4.7
Total (N=2413)	223	9.2	±1.2	100	

4.2.3 Misdiagnosed conditions

Overall, 303 incorrect diagnoses were made, which encompassed 123 different diseases or conditions. Out of these 303 incorrect diagnoses, 38 conditions were incorrectly identified more than once, accounting for 226 of the misdiagnoses. These are known as recurrent diagnoses. Additionally, there were 87 instances where a condition was misdiagnosed only once. Appendix A shows results of the misdiagnosed conditions among the 223 patients misdiagnosed.

4.2.4 Classification of misdiagnosis

This subsection analyzes patient cases that were incorrectly diagnosed and categorizes them according to the criteria explained in subsection 3.12.1.2. Of the 223 patients who were misdiagnosed, 158 (70.9% [95% CI: 64.9–76.9%]) were classified under Class I misdiagnosis. The classification implies that 158 (70.9%) of the misdiagnosed patients had initial and final diagnoses

University of Ghana http://ugspace.ug.edu.gh

under different ICD-11 major diagnostic groups, requiring significant changes to treatment plans. Further analysis revealed that 17 (7.6%) of the misdiagnosed patients were categorized under Class II misdiagnosis. Although both the initial admission diagnosis and the final discharge diagnosis belonged to the same major ICD-11 grouping, their parent groups were different, so the treatment strategies needed to be changed significantly.

The results further informed that 30 (12.1%) of the 223 misdiagnosed patients had a Class III classification. Here, the initial and final diagnoses belonged to different or same major diagnostic grouping but different parent grouping. However, the change of diagnosis did not necessitate treatment change. Only 21 (9.4%) of the 223 misdiagnosed patients were classified as IV misdiagnosis. The results were related to each of the ICD-11 categorisations shown below. The results are displayed in figure 4.1.

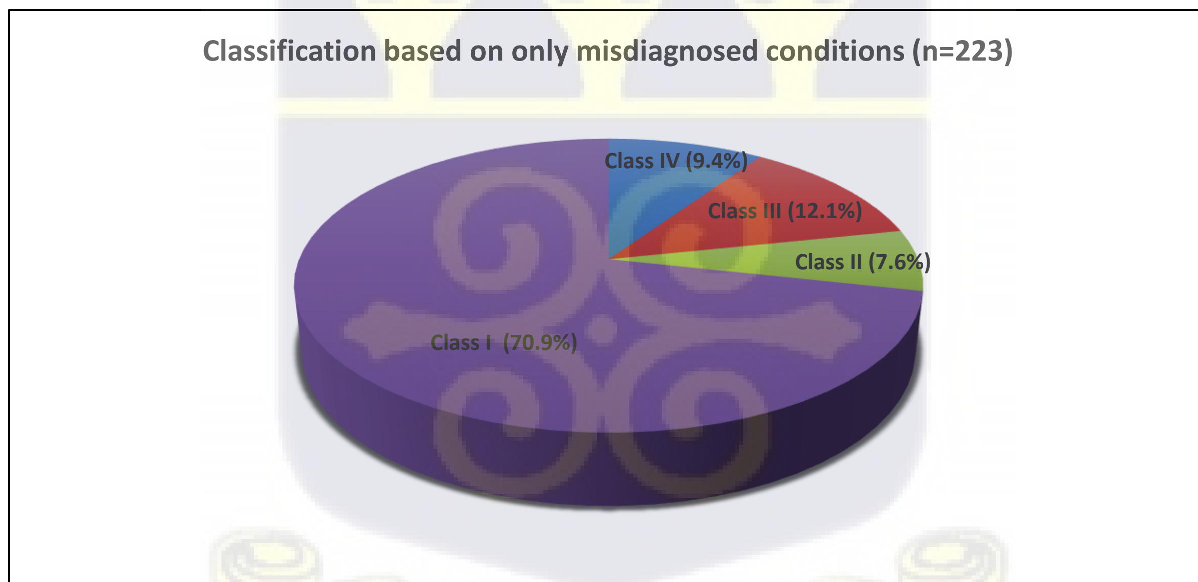


Figure 4.1: Classification of misdiagnosis (n=223)

4.2.5 The topmost major diagnostic groupings and disease conditions misdiagnosed

The Pareto principle was used to determine the commonly or frequently misdiagnosed conditions and major diagnostic groupings.

University of Ghana http://ugspace.ug.edu.gh

4.2.5.1 Pareto Chart for topmost misdiagnosed major diagnostic groupings

Misdiagnosis was noted in 20 out of the 26 (76.9%) major diagnostic groupings as revealed in Figure 4.2. Seven ICD-11 major diagnostic groupings cumulatively accounted for over three quarters (at least 80%) of the misdiagnosed conditions. Because of this, they are deemed the "big seven" major diagnostic groupings for consideration of common misdiagnoses. These included certain infectious or parasitic disease 98/303 (32%), diseases of the digestive system, 36/303 (12%), diseases of the circulatory system, 34/303 (11%), endocrine, nutritional or metabolic disorders, 28/303 (9%), diseases of the genitourinary system 20/303 (7%), diseases of the respiratory system, 20/303 (7%), and diseases of blood and blood forming organs 16/303 (5%) forming 7 core disease conditions.

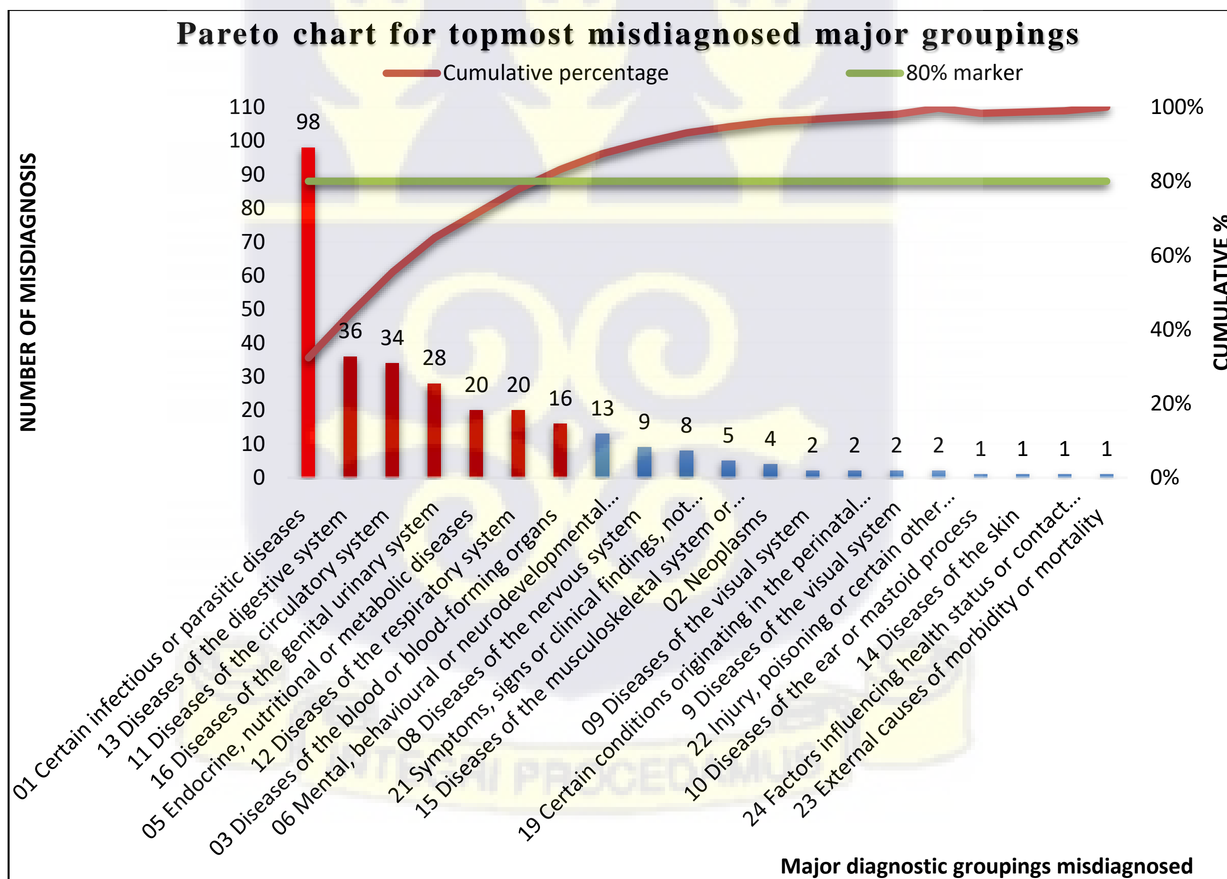


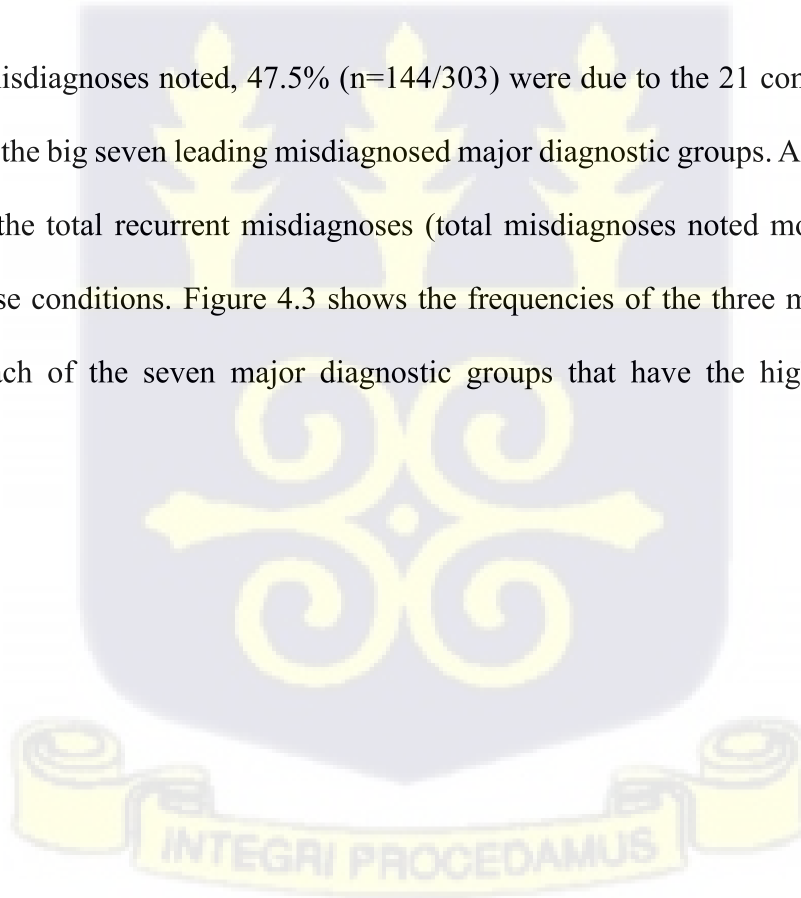
Figure 4.2: The Pareto chart for the topmost misdiagnosed major diagnostic groupings

University of Ghana http://ugspace.ug.edu.gh

4.2.5.2 Conditions most frequently misdiagnosed in each of the "big seven" misdiagnosed major diagnostic groupings

Within the major diagnostic grouping of infections or parasitic diseases, malaria emerged as the most misdiagnosed condition. The predominant misdiagnosed conditions within the digestive, circulatory, genitourinary, and respiratory systems were identified as peptic ulcers, hypertension, urinary tract infection, and chronic obstructive pulmonary disease, respectively. Diabetes mellitus and anaemia were found to be the most frequently misdiagnosed conditions within the categories of endocrine, nutritional and metabolic disorders, and diseases of blood and blood-forming organs, respectively.

Of all the 303 misdiagnoses noted, 47.5% (n=144/303) were due to the 21 conditions frequently misdiagnosed in the big seven leading misdiagnosed major diagnostic groups. Additionally, 63.7% (n=144/226) of the total recurrent misdiagnoses (total misdiagnoses noted more than once) are attributed to these conditions. Figure 4.3 shows the frequencies of the three most misdiagnosed conditions in each of the seven major diagnostic groups that have the highest misdiagnosis prevalence.



University of Ghana http://ugspace.ug.edu.gh

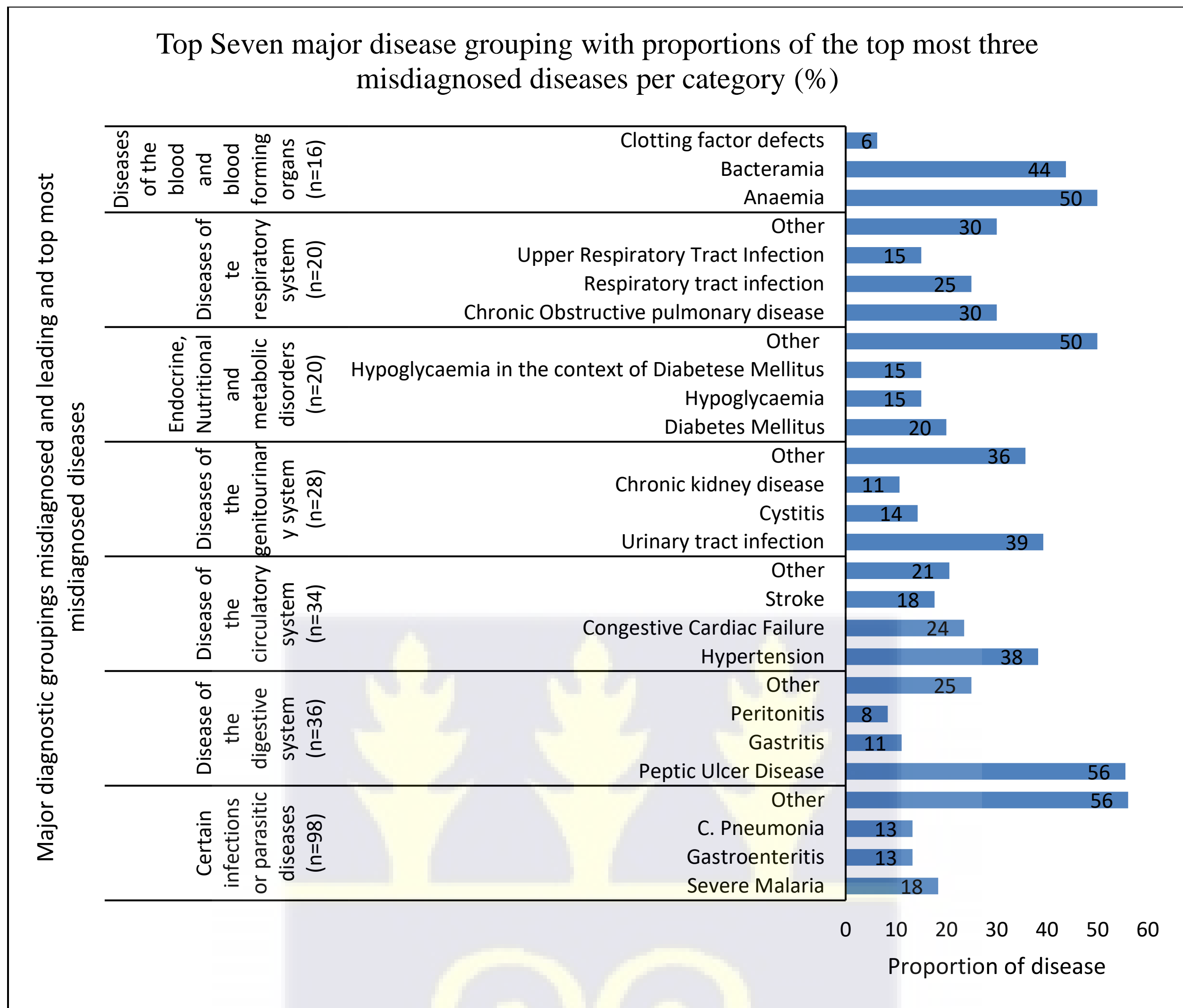


Figure 4:3. The three topmost misdiagnosed diseases for each of the topmost misdiagnosed major diagnostic groupings

4.2.5.3 Pareto Analysis of The Topmost Misdiagnosed Diseases Misdiagnosed Occurring More Than Once

A Pareto analysis was employed to identify these conditions, also termed as the “vital few” in the context of quality improvement. This was intended to detect diseases that are most frequently misdiagnosed that hospitals should strategically concentrate on improving the precision of diagnosis for conditions so as to reduce the occurrence of misdiagnoses. This analysis took into

University of Ghana http://ugspace.ug.edu.gh

account diseases that were misdiagnosed more than once. Consequently, for the purpose of the Pareto analysis, 38 diseases were selected from a total of 123 misdiagnosed conditions. The remaining 87 conditions, each misdiagnosed only once, were considered under the "trivial many" in the Pareto analysis.

Only 19 diseases (20% of the 38 recurrent misdiagnoses) accounted for 80% of the frequently misdiagnosed conditions. The purple line in the Pareto chart running from the red cumulative frequency percentage line falling under the green 80% cut offline shows the 19 'vital few' disease or conditions for which priority should be placed to reduce patient misdiagnosis.

Among these 19 diseases, 12 were under the classification of common causes of admission. They included; peptic ulcer disease [20/226 (8.8%)], severe malaria [19/226 (8.4%)], hypertension [14/226 (6.2%)], gastroenteritis [14/226 (6.2%)], pneumonia [13/226 (5.8%)], urinary tract infection [12/226 (5.3%)], enteric fever, [12/226 (5.3%)]), septicaemia [9/226 (4%)], bacteraemia [8/226 (3.5%)], severe anaemia [8/226 (3.5%)], respiratory tract infection [4/226 (1.8%)], and diabetes mellitus [4/226 (1.8%)].

The seven uncommon causes of admission among the topmost misdiagnosed diseases included; tuberculosis [9/226 (4%)], congestive cardiac failure 7/226 (3.1%], stroke [6/226 (2.7%)], chronic obstructive pulmonary disease [6/226 (2.7%)], cystitis [4/226 (1.8%)], cryptococcal meningitis [4/226 (1.8%)] and gastritis [4/226 (1.8%)]. Non-communicable diseases constituted the highest proportion of commonly misdiagnosed diseases. The results are shown in Figure 4.4.

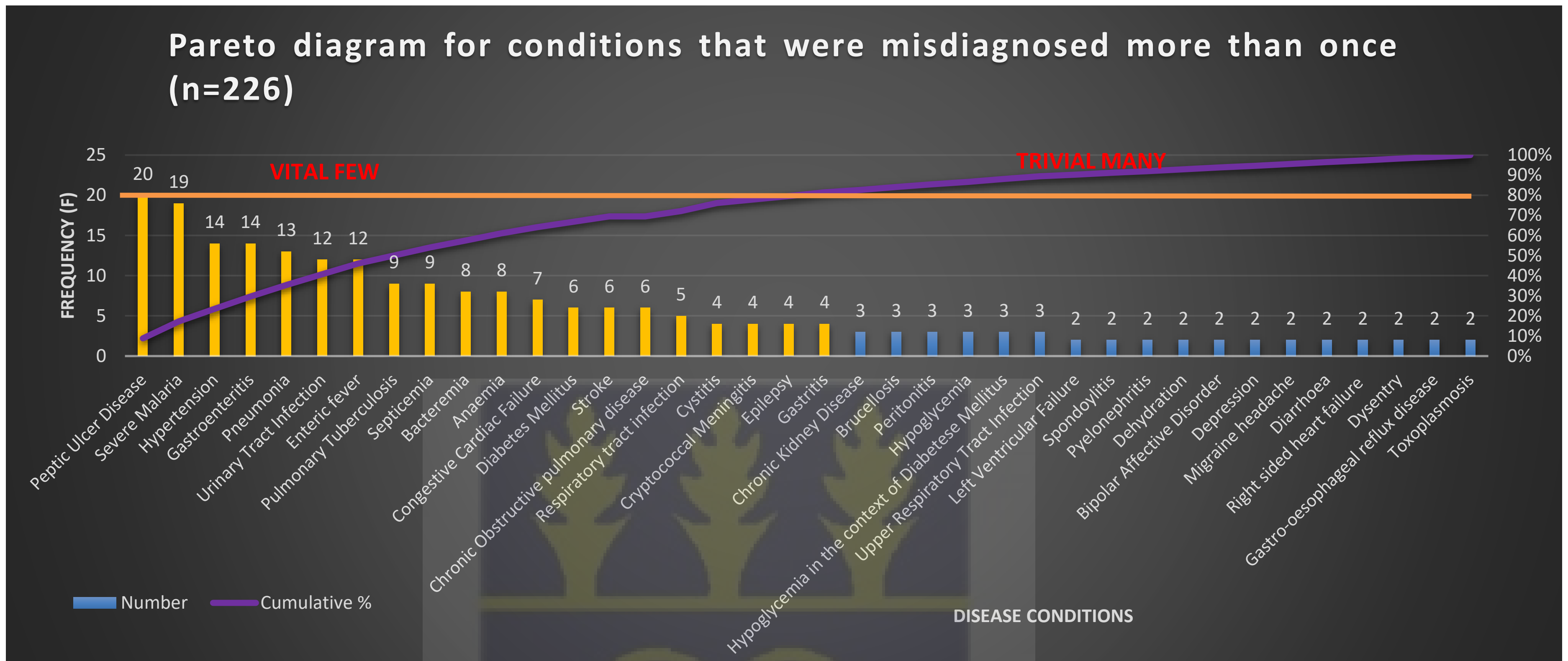


Figure 4.4: Overall topmost misdiagnosed diseases or conditions

NB. The following medical conditions were misdiagnosed once and can be counted among the trivial many

Acute Appendicitis, Acute Hepatitis B, Acute Kidney infection, Acute Pyelonephritis, Acute Viral Hepatitis, Alcoholic intoxication Alcoholic liver disease, Allergic Rhinitis, Aspiration Pneumonia, Arthritis, Bacterial infection, Bilateral Orchitis, Bronchitis, Cancer of the cervix Cellulitis, Cervical Lymphadenitis, Chicken Pox, Chronic cholecystitis Chronic Myeloid Leukemia, Chronic Renal Failure, Chronic Superlative Otitis Media, Clotting factors defects, Congenital melena, Constipation, Conversion disorder, Corpolmonale, Dementia associated motor complex due to HIV Depression, ISS (FEAR OF HIV), Diabetic Neuropathy, Drug Induced, Gastritis, Drug Induced Hepatitis, Dysmenorrhea, Esotropia, Fatigue syndrome, Food poisoning, Functional level injury of the Spinal (Lumbar), Fungal infection, Head injury, Hepato-splenomegaly, Herpes zoster, Hiccough, HIV disease clinical stage 4 with no TB OR Malaria (TB Ruled out after investigation), HIV Encephalopathy, HIV/AIDS Defaulter admitted for counselling, Hyperplasia of the Prostate, Hypoalbuminemia, Hysteria, Interstitial Pneumonitis, Ischemic Heart Disease, Kaposi Sarcoma, Langerhans cell histiocytosis, Liver Cirrhosis, Lumbar disc prolapse, Malnutrition in an adult, Manic Mood Symptoms induced by drugs, Mental confusion not specified, Myelopathy, Nephritis, Neural syphilis, Obesity, Oculogyric crisis, Oral candidiasis, Organic Brain Syndrome, Organophosphate poisoning, Oral pharyngeal Candidiasis, Palpitations, Pharyngitis, Physiological jaundice Pleurisy, Protein energy Malnutrition, Psychosis, Renal failure, Schizophrenia, Severe Acute Malnutrition, Spinal Cord Compression, Steven Johnson syndrome, Syncope, Syphilis, Spondylosis of Lumbar Spine, Ulcerative Colitis, Underweight in an adult, Upper Gastrointestinal Bleeding, Viral Meningitis, Vitamin D deficiency, Wernicke Encephalopathy.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

4.2.5.4 Misdiagnosis classification based on communicable or non-communicable disease status

An analysis was conducted on the misdiagnosed diseases, categorizing them based on communicable or non-communicable classification. The purpose of this examination was to determine which category, between communicable and non-communicable diseases, was more frequently subject to misdiagnosis. Out of the 123 misdiagnosed diseases, 102 (82.9%) were non-communicable diseases, while 21 (17.1%) were communicable diseases. This suggests that noncommunicable diseases are more frequently subject to misdiagnosis compared to communicable diseases.

Among the 19 vital few recurrent misdiagnosed diseases, 12 (63.2%) were non-communicable diseases while 7 (36.8%) were communicable diseases. The non-communicable diseases among the commonly misdiagnosed diseases included; peptic ulcer disease, hypertension, septicaemia, bacteraemia, severe anaemia, diabetes mellitus, congestive cardiac failure, stroke, chronic obstructive pulmonary disease, cystitis, cryptococcal meningitis and gastritis. The results are displayed in the Pareto chart in Figure 4.3.

4.2.6 Logistic regression analysis to determine factors associated with patient misdiagnosis

This section presents results obtained from both bivariate and multivariable logistic regression conducted to establish factors associated with patient misdiagnosis.

4.2.6.1 Bivariate logistic regression analysis: Association between patient, disease, environment and health system factors and misdiagnosis

The results from the bivariate analysis of the association between misdiagnosis and the independent variables are presented along the constructs of the conceptual framework of patient related factors, disease related factors, service delivery, and environmental factors. At this stage,

University of Ghana http://ugspace.ug.edu.gh

the unadjusted ratio (uOR) mean that the findings do not take into account the influence, if any, of other factors or potential confounding variables that might also affect the likelihood of misdiagnosis.

Compared to the reference group (0–9 years), the likelihood of misdiagnosis increased with age, with the highest odds observed in individuals aged 50 years and above. This age group had a significantly greater risk of misdiagnosis, with an odds ratio of 23.1 (uOR=23.1, 95% CI=12.41-42.06, p <.001). Study findings further indicated a statistically significant association between being male and receiving a wrong diagnosis (uOR 2.2, 95% CI: 1.68–3; *P*<.001). This suggests that male patients are more likely to be associated with misdiagnosis than their female counterparts. Patients who were classified as new or initial attendees, meaning they had their first hospital visit within the month of the admission, demonstrated a lower likelihood of association with misdiagnosis (uOR = 0.3, CI: 0.16-0.42; *P*<.001). This is in contrast to returning patients, who had previous hospital visits within the month of their admission.

Disease related factors: A patient whose final diagnosis was in the category of commonly seen diseases within the hospitals was less likely to be associated with misdiagnosis (uOR=0.2; 95% CI:0.12-0.3; *P*<0.001) compared to one whose final diagnosis had a combination of both common and uncommon diseases. The likelihood of being associated with misdiagnosis was found to be significantly lower in patients who did not have any pre-existing conditions at the time of their initial hospital admission, compared to those with underlying diseases (uOR = 0.3, 95% CI: 0.21-0.37; *P*<0.001). The number of presenting complaints the patient had did not have any significant association with patient misdiagnosis.

University of Ghana http://ugspace.ug.edu.gh

Health Services delivery: The results showed that being misdiagnosed was significantly associated with having been admitted in H2 (uOR= 2, 95% CI: 1.3-3.8; $P< 0.05$] and H2 (uOR=1.6, 95% CI: 1.04-2.62; $P<0.05$) than in those admitted in H1 hospital. The likelihood of misdiagnosis was significantly lower in patients who had not been referred from other health facilities than in those who had been referred (uOR = 0.3, 95% CI: 0.2-0.48; $P<0.001$). The likelihood of misdiagnosis was lower in patients who were initially diagnosed with laboratory or radiological investigations (uOR = 0.6, 95% CI: 0.42-0.8; $P<0.05$).

The study found a significant correlation between the timing of a patient's admission and the likelihood of misdiagnosis. Patients admitted at night were 3.5 times more likely to be associated with misdiagnosis (uOR = 3.5, 95% CI = 2.48–5.79; $P<0.001$) than those admitted during the day. Furthermore, the study also revealed that patients admitted over the weekend were 1.4 times more associated with misdiagnosis (uOR = 1.4, 95% CI: 1.04–2; $P<0.05$) than those admitted on a weekday. The factors found to be significantly associated with patient misdiagnosis at bivariate level were thus considered for the multivariable analysis. Tables 4.3a and 4.3b presents results of the bivariate logistic regression analysis of the factors associated with misdiagnosis among inpatient.

Table 4.3a: Bivariate logistic regression analysis: Association between patient, disease, environment and health system factors and misdiagnosis (N=2431)

Variable		Total n	Not Misdiagnosed (f)	Not Misdiagnosed %	Misdiagnosed (f)	Misdiagnosed %	p-value	95% CI LL		95% CI UL
Hospital (N=2431)	H1	481	449	20.3	32	14.3				
	H2	489	427	19.3	62	27.8	0.002	1.3	-	3.18*
	H3	485	434	19.7	51	22.9	0.034	1.04	-	2.62*
	H4	489	445	20.2	44	19.7	0.176	0.86	-	2.23
	H5	487	453	20.5	34	15.3	0.839	0.64	-	1.74
Hospital (N=2431) Age category (N=2431)	0-9	1003	990	44.8	13	5.8				
	10 to 19	408	382	17.3	26	11.7	0	2.64	-	10.19*
	20-29	315	274	12.4	41	18.4	0	6.02	-	21.57*
	30-39	199	165	7.5	34	15.2	0	8.11	-	30.36*
	40-49	141	117	5.3	24	10.8	0	7.74	-	31.51*
	50 years and above	365	280	12.7	85	38.1	0	12.71	-	42.06*
Sex	Female	1262	1,186	53.7	76	34.1				
	Male	1169	1,022	46.3	147	65.9	0	1.68	-	3.00*
Referral status of the patient	Referred	131	101	4.6	30	13.4				
	Not referred	2,300	2,107	95.4	193	86.6	0	0.2	-	0.48*
Type of the patient Sex	Old patient	90	66	3.0	24	10.8				
	New patient	2341	2,142	97.0	199	89.2	0	0.16	-	0.42*
Number of presenting complaints	More than 3	317	284	12.9	33	14.8				
	1 to 3	2,114	1,924	87.1	190	85.2	0.414	0.09	-	0.11
Initial diagnosis made after investigations	No	390	337	15.3	53	23.8				
	Yes	2041	1,870	84.7	170	76.2	0.001	0.42	-	0.80*

Table 4.3b: Bivariate logistic regression analysis: Association between patient, disease, environment and health system factors and misdiagnosis (N=2431)

Variable		Total	Diagnostic status				p-value	95% CI	
			Not Misdiagnosed		Misdiagnosed				
		n	(f)	%	(f)	%		LL	UL
Patient has an underlying disease	Yes	376	296	13.4	80	35.9			
	No	2055	1,912	86.6	143	64.1	0.000	0.21	- 0.37*
The number of morbidities	One disease	1991	1,832	83	159	71.3			
	Comorbidity (2 diagnoses)	390	343	15.5	47	21.08	0	1.96	- 7.14*
	Multimorbidity (3 diseases or more)	50	33	1.5	17	7.62	0	3.2	- 11.1*
Time of admission	Day time	2,076	1,908	86.4	168	75.3			
	Evening	223	201	9.1	22	9.9	0.362	0.78	- 1.98
	Night	132	99	4.5	33	14.8	0	2.48	- 5.79*
Period of the week patient was admitted	Weekday	1976	1,806	81.9	169	75.8			
	Weekend	455	400	18.1	54	24.2	0.026	1.04	- 2.00*
Commonness of the final diagnosis	Had both common and uncommon disease	144	116	5.3	28	12.6			
	Only common disease	1861	1,780	80.6	81	36.3	0	0.12	- 0.30*
	Only uncommon disease	426	312	14.1	114	51.1	0.081	0.95	- 2.41

University of Ghana http://ugspace.ug.edu.gh

4.2.6.2 Multivariable logistic regression analysis: Association between patient, disease, environment and health system factors and misdiagnosis

This section presents results of the factors (independent variables) that were associated with misdiagnosis of admitted patients at multivariable logistic regression analysis after adjusting for other factors. The findings of these significant factors are presented along the constructs of patient related factors, disease related factors, service delivery, and environmental factors.

Disease related factors

Patients with no underlying diseases were 37% less likely to be associated with misdiagnosis (aOR=0.63; 95% CI=0.43-0.91, *P*=0.015) compared to patients with underlying diseases. Patients with multimorbidity were 4.71 times likely to be misdiagnosed (aOR=4.71; 95% CI=1.91-11.65, *P*=0.001) compared to patients with single morbidity (disease/condition). Patients treated for uncommon diseases of admission to the hospital were 2.57 times likely to be misdiagnosed (aOR=2.57; 95% CI=1.28-5.18, *P*<0.01) compared to patients who had both common and uncommon diseases of admission.

Patient related factors

The results showed that patients' age was significantly associated with misdiagnosis. The age group with the highest likelihood of misdiagnosis compared to the youngest age category (0-9 years) was the 50 years and above age group. Patients in this age bracket were 12.14 times more likely to be misdiagnosed compared to the reference age category (aOR=12.14, 95% CI=6.41-23.01, *P*=0.001). The odds of being misdiagnosed among male patients were increased by 89% compared to female patients (aOR=1.89 95% CI=1.35-2.64, *P*=0.001).

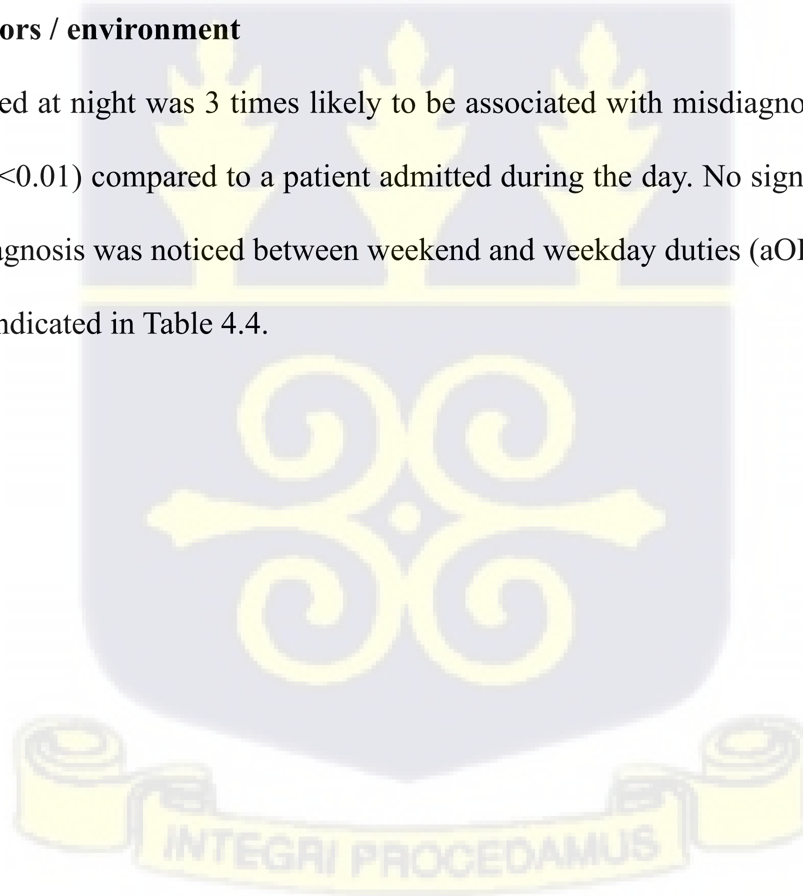
University of Ghana http://ugspace.ug.edu.gh

Health Service delivery:

The findings revealed that a patient admitted at H2 had 95% increased likelihood of being misdiagnosed compared to a patient admitted at H1 (aOR 1.95 95% CI =1.17-3.25, *P*=0.001). Patients who had not been referred to the hospital (moved in direct from home) were 49% less likely to be misdiagnosed compared to patients who had been referred from other lower-level health facilities or clinics (aOR=0.51; 95% CI=0.31-0.86, *P*=0.011). No significant association with misdiagnosis was found between being admitted with the diagnosis made being backed with laboratory investigation and without laboratory investigation (*P*=0.41).

Contextual factors / environment

A patient admitted at night was 3 times likely to be associated with misdiagnosis (aOR 3.0 95% CI=1.81-5.02, *P*<0.01) compared to a patient admitted during the day. No significant association of patient misdiagnosis was noticed between weekend and weekday duties (aOR=1.23, *P*=0.279). The results are indicated in Table 4.4.



University of Ghana http://ugspace.ug.edu.gh

Table 4.4: Multivariable logistic regression analysis: Association between patient, disease, environment and health system factors and misdiagnosis (N=223)

	Variable	Misdiagnosed n	%	Adjusted Odds Ratio	P value	95% CI
Hospital	H1	32	14.4	Reference		
	H2	62	27.8	1.95	0.01	1.17 - 3.25*
	H3	51	22.9	1.40	0.213	0.83 - 2.37
	H4	44	19.7	0.98	0.956	0.57 - 1.69
	H5	34	15.3	0.90	0.722	0.51 - 1.59
Age	0-9	13	5.8	Reference		
	10 to 19	26	11.7	4.61	0.0000	2.30 - 9.25*
	20-29	41	18.4	8.15	0.0000	4.18 - 15.89*
	30-39	34	15.2	8.12	0.0000	3.99 - 16.54*
	40-49	24	10.8	7.88	0.0000	3.71 - 16.73*
	50+	85	38.1	12.14	0.0000	6.41 - 23.01*
Sex	Female	76	34.1	Reference		
	Male	147	65.9	1.89	0.0000	1.35 - 2.64*
Referral status	Referred	30	13.4	Reference		
	Not referred	193	86.6	0.51	0.011	0.31 - 0.86*
Case type	Old patient	24	10.8	Reference		
	New patient	199	89.2	0.94	0.85	0.51 - 1.75
Lab tests done	No	53	23.8	Reference		
	Yes	170	76.2	1.18	0.41	0.79 - 1.76
Underlying disease	Yes	80	35.9	Reference		
	No	143	64.1	0.63	0.015	0.43 - 0.91*
Number of morbidities	One disease	159	71.3	Reference		
	Comorbidity (2 diseases)	47	21.1	1.49	0.1	0.93 - 2.38
	Multimorbidity	17	7.6	4.71	0.001	1.91 - 11.65*
Time of admission	Day time	168	75.3	Reference		
	Evening	22	9.9	1.26	0.395	0.74 - 2.14
	Night	33	14.8	3.00	0.000	1.81 - 5.02*
Period of the week	Weekday	169	75.8	Reference		
	Weekend	54	24.2	1.23	0.279	0.84 - 1.79
How common the diagnosis is	Combination of common and uncommon disease	28	12.6	Reference		
	Only common disease	81	36.3	0.55	0.083	0.28 - 1.08
	Only uncommon diseases	114	51.1	2.57	0.008	1.28 - 5.18*

University of Ghana http://ugspace.ug.edu.gh

4.3 Qualitative Results

This section presents an analysis of the perspectives of medical officers and clinicians of factors influencing misdiagnosis in hospitals in Central Uganda. The results derived from the quantitative study serve as the backbone of their reasoning and explanations. The perspectives are grouped into major themes, including disease-related issues, health workforce concerns, information and technology, medicine, and supply issues.

4.3.1 Background of the interviewees

Clinical and medical officers were numbered six each. Only three interviewees were women. The majority of interviewees had careers spanning more than fifteen years. Table 4.5 lists the health workers who participated in the in-depth interviews.

Table 4.5: Characteristics of the interviewees for the qualitative interviews

Rank category of profession	Code assigned	Age range	Sex	Years of work experience
Clinical Officer 1	CO-1	50-60	Male	30+ years
Clinical Officer 2	CO-2	40-50	Male	15 years
Clinical Officer 3	CO-3	40-50	Female	20+ years
Clinical Officer 4	CO-4	40-50	Male	15 years
Clinical Officer 5	CO-5	40-50	Female	20+
Clinical Officer 6	CO-6	50-60	Male	30+
Medical Officer 1	MO-1	40-50	Male	15 years
Medical Officer 2	MO-2	40-50	Male	15 years
Medical Officer 3	MO-3	50-60	Male	25 years
Medical Officer 4	MO-4	40-50	Female	15+ years
Medical Officer 5	MO-5	40-50	Male	15+ years
Medical Ofiicer 6	MO-6	40-50	Male	5+years

4.3.1 Disease related factors and misdiagnosis

This subsection with three sub-themes examines the opinions expressed on the relationship between the disease related factors and misdiagnosis.

University of Ghana http://ugspace.ug.edu.gh

4.3.1.1 Common conditions top list of misdiagnosed diseases

Since diagnosticians are accustomed to seeing common conditions in their practice, it would seem like they would make better diagnoses of these conditions. In the Pareto analysis, the most prevalent misdiagnosed diseases were among the most common conditions for patient admission to hospitals. These illnesses included severe malaria, peptic ulcers, pneumonia, urinary tract infections, and anaemia and misdiagnoses occur when laboratory services are closed, or Physician is on shift. There are some justifications given for this circumstance.

> *[…] Misdiagnosis of conditions like malaria, peptic ulcer disease, and anemia have been attributed to diagnosticians' failure to diagnose when no investigations have been done. This might occur, for example, if the patient visits the emergency department or the outpatient clinic after the day shift. This might be when the laboratory is closed or at night […]* (CO-1).

In other cases, some diagnosticians assigned a diagnosis more similar to the suspected diagnosis while waiting for confirmatory tests.

> *[…] If you choose those cases at night, you will discover that some may even lack a provisional diagnosis, depending on the diagnostician present. And then we conduct investigations in the morning and arrive at a final diagnosis […]* (CO-6).

As a result, it was common to find a patient with tuberculosis who was incorrectly diagnosed as having a lower respiratory infection. The misdiagnosis of other diseases like tuberculosis and cryptococcal meningitis, whose samples may have needed to be transported to other reference laboratories, has also been cited as a problem.

4.3.1.2 Low index of suspicion of certain diseases

The clinicians' low level of suspicion for some diseases in particular age groups was a reason is blamed for misdiagnosis:

University of Ghana http://ugspace.ug.edu.gh

> *[…] A child with tuberculosis or diabetes may receive a misdiagnosis in our hospital due to the rarity of such illnesses in young children […]* (CO-3)

A diagnostician might not consider checking a patient's blood pressure if they are a young adult with hypertension. This is because the disease is not highly suspected given their age. This is especially true if the patient does not exhibit hypertension symptoms.

> *[…] It is possible to forego taking a blood pressure reading on a young adult complaining of headaches but exhibiting no signs of the condition, even if hypertension is the patient's actual condition […]* (CO-1).

The index of suspicion for a specific disease among diagnoses may affect patient misdiagnosis. Diseases that are uncommon in patients or rare age groups are probably more likely to cause this.

4.3.1.3 Diagnosticians' propensity to make diagnoses they are familiar with

The process of diagnosing illnesses can be challenging, especially for uncommon illnesses in hospitals. Clinical practice, however, mandates that a diagnostician should at the very least establish a working diagnosis prior to recommending a course of treatment. In such a difficult situation, clinicians may make a diagnosis that closely resembles the challenging condition at hand:

> *[...] There are signs and symptoms that can indicate a particular diagnosis that clinicians know. In most cases, the illness is widespread in their area. For instance, if a patient presents with abdominal and epigastric pain and the clinician is unfamiliar with cardiac issues, he or she may assume that the patient has typhoid or peptic ulcers if there is no blood coughed up. This is the case because that is what they were taught or accustomed to. As a result, when treating patients with these complaints, they are more likely to diagnose ulcers or Typhoid when the condition could be heart related […]* (MO-2).

4.3.1.4 Presence of underlying diseases and misdiagnosis

Interviewees indicated that the presence of pre-existing conditions could potentially lead to a bias in clinical diagnosis. This bias might result in an overemphasis on these known conditions, thereby

University of Ghana http://ugspace.ug.edu.gh

overshadowing the possibility of other diseases that could be the actual cause of the patient's symptoms. Consequently, this could lead to an inaccurate diagnosis, as the true root cause of the patient's condition might be overlooked:

> *[…] With all three conditions, you could not visit the hospital. A particular morbidity must have motivated you to visit the hospital for treatment. However, the issue is that when a patient first arrives, he or she will inform the clinician, "You know, I also have diabetes, I have high blood pressure, and I have this." As a result, even clinicians might be puzzled and neglect to pay attention to what led to this patient's referral […]* (MO-1).

The clinician may encounter confusion when dealing with patients who have pre-existing conditions and possess extensive knowledge of their own diseases. This situation can become particularly complex when the patients are unable to communicate, such as when they are unconscious, and their caregivers, who are well-informed about the patient's comorbidities, become the primary source of information. The caregivers' understanding and interpretation of the patient's condition may inadvertently lead to diagnostic confusion, potentially resulting in misdiagnosis:

> *[…] Sometimes it is possible, particularly when unconscious patients in critical condition are brought in by frantic friends or family members who usually only know and exaggerate about the patient's underlying diseases. If the non-critical clinician agrees with the attendants' viewpoint, these patients are most likely to receive a false diagnosis […]* (CO-4).

Upon the mention of an underlying disease, a clinician's primary focus often shifts toward understanding and managing that disease or the complications associated with that particular disease. This focus can sometimes overshadow the consideration of other potential health conditions that the patient may have:

University of Ghana http://ugspace.ug.edu.gh

> *[…] Instead of identifying any other possible illness, clinicians may think about the complications of an underlying disease should the patient mention it […]* (MO-1).

4.3.1.5 Patient related factors and misdiagnosis

This section presents analysis of results of how patient related factors could influence misdiagnosis among the diagnosticians. There are two main subthemes in this section which include less misdiagnosis among children and male patients likely to be misdiagnosed more than women.

Misdiagnosis among children and older age groups

The health personnel participating in this study agreed that children were less likely to receive a mistaken diagnosis than adults or the elderly. They reported that children do not lie about their symptoms as some adults may; their pathologies are simpler and more predictable in children than in adults, and clinicians spend more time examining children than adults in order to confirm what the patient has said. In some hospitals, children must also be seen by the most experienced clinicians.

Children's presenting complaints are straight forward

Most interviewees had a strong conviction that children rarely feign illnesses or fabricate symptoms. Therefore, paediatric patients have a lower likelihood of misdiagnosis than adults, since children's symptoms are often genuine indicators of their health conditions:

> *[…] Some adults lie when presenting symptoms, but children do not. You will be able to tell if a child is vomiting, whether he is playing, or not. Adults usually require you to sift through a lot of information before getting the truth from them. A woman might come here and pretend to be ill, act sick, in order to test the husband's love […]* (MO-5)

Thus, the clinician can more easily navigate the diagnostic process for children by using the information at hand and the examinations they carry out.

University of Ghana http://ugspace.ug.edu.gh

Fewer pathologies in children lead to better diagnosis

Health workers also reported that paediatric patients have fewer conditions than adults. When diagnosing children, unlike adults, a diagnostician must consider a small group of diseases:

> *[…] Well, I believe that the diseases that account for under-five morbidity are just a select few and predictable. For instance, when a child has a fever, I can tell you that the clinician is probably thinking it is bacteremia or malaria because they are the most common here. If a child has diarrhea, it is obvious. When a child has cough, fever, and breathing difficulties, pneumonia is considered the most likely cause. Then, naturally, there are some problems with anemia and sickle cell disease in regions where they are quite prevalent […]* (Medical Officer 4)

Thus, correctly diagnosing a patient is certainly more likely if the patient is a child than if the patient is an adult or an elderly person.

Complexities of conditions in children and adults

It was also mentioned that, compared to adult conditions, children's conditions were less complicated. Getting a diagnosis for them was thus fairly simple:

> *[…] A pediatric patient may most likely present with symptoms that are simple to diagnose, such as dehydration, pneumonia, malaria, or a sickle cell disease crisis, in contrast to adult medical conditions, where some patients may present with complex conditions that call for a certain level of expertise, knowledge, and competency to make a proper diagnosis […]* (MO- 3).

Adult conditions require a thorough history and examination. However, this is typically impossible in the emergency room and outpatient department.

Misdiagnosis in male and female patients

According to clinicians, male patients are more prone to misdiagnosis than their female counterparts. This is primarily attributed to male patients' tendency to be less forthcoming about

University of Ghana http://ugspace.ug.edu.gh

the severity and full range of their symptoms. This leads to ambiguity and challenges for health workers during the diagnostic process, thereby increasing the likelihood of a misdiagnosis:

> *[...] They come with their own preconceived ideas about what to say about their illness. "Now, please do this to me; if not, I'll leave." However, women are more likely to provide pertinent information when asked about an illness during a consultation [...]* (CO-3).

Interviewees expressed a belief that male patients tend to less frequently engage with the healthcare system than their female counterparts. This infrequent interaction is thought to result in a deficiency in the skills required for active participation in clinical decision-making processes. Consequently, male patients may have difficulty responding effectively to questions posed by clinicians during the history-taking phase of the diagnostic process. In this case, the diagnostic outcomes could potentially become less accurate and less effective:

> *[…] Men are not exposed to the healthcare system and its processes. They thus cannot collaborate and fully devote themselves to the clinician. On the other hand, women are more forthcoming with them because they frequently interact with facility clinicians […]* (CO-2).

Interviewees pointed out that male patients are generally more reserved, offering unclear responses. Having these unclear responses can pose challenges in as it hinders the ability to steer the diagnostic process effectively:

> *[...] Female patients are expected to disclose all of their complaints, including their secrets if they are related to their illness in some way. Men are more reserved, so getting information from them might require more shrewdness [...]* (Medical Officer 5)

Furthermore, it was revealed that men who need inpatient care are more likely to come to the hospital late and seriously ill. In such a situation, navigating the diagnostic process is made harder, raising the risk of a false positive.

University of Ghana http://ugspace.ug.edu.gh

> *[…] Men often delay their visit to the hospital, resulting in severe illness by the time they seek help. They tend to arrive at the hospital only when their condition has significantly deteriorated, often presenting with multiple diseases which are difficult to diagnose. Their health-seeking behavior needs improvement […]* (MO-4).

Men are being identified as more prone to misdiagnosis compared to women:

> *[…] Are you surprised if it is men who are misdiagnosed most? You know our health system. Save for the safe male circumcision programs, most of the emphasis was placed on women and children and men are left out of most public health care […]* (MO-1)

Men's health in this regard appears to be neglected, as the health system in Uganda has been created to place a strong emphasis on mothers and children's health.

4.3.1.6 Human resources for health and misdiagnosis

This sub-section examines diverse perspectives on the potential influence of human resources for health on misdiagnosis. Embedded within this overarching theme are four distinct subthemes: diagnostician qualification, the educational preparation of clinicians, the organization of human resources for health, and the numerical strength of the clinicians.

Qualification of diagnostician and admission

From the interviewees' perspective, the shortage of clinicians in the health facilities sometimes necessitates nurses and student clinicians to assume some of the diagnostic responsibilities usually reserved for clinicians. However, there is a heightened probability of misdiagnosis when patients are diagnosed by student clinicians or nurses if they are not supervised. This is because nurses and student clinicians are perceived to have less proficiency in diagnostics, especially when confronted with atypical diseases. Both student clinicians and nurses are considered to have insufficient

University of Ghana http://ugspace.ug.edu.gh

training, lack experience, and possess limited knowledge, particularly in relation to certain diseases:

> *[…] Diagnosticians in the outpatient department admit patients based on their assessment. That assessment will depend on the diagnostician's expertise or experience. As a result of understaffing, nurses and inexperienced students sometimes take on clinician roles and are likely to err due to their inexperience in diagnostic procedures […]* (MO- 2).

Educational preparations of the clinicians

Within this sub-theme, the discussion focused primarily on the clinicians' training aspects as well as the temporal gap between clinical training and misdiagnosis. Additionally, a significant portion of the conversation focused on mentorship methodologies and processes used during their hospital practicums.

Training of Clinicians' and occurrence of misdiagnosis

The quality and recency of a clinician's training have been identified as significant factors contributing to misdiagnosis. The nature of the training received by diagnosticians is directly linked to their ability to accurately diagnose diseases. Furthermore, the timing of a clinician's training plays a crucial role in their diagnostic capabilities. Given the rapid advancements in diagnostic technologies, clinicians who completed their training over two decades ago may struggle with accurate diagnosis if it involves the use of contemporary investigative technologies and methods with which they are unfamiliar:

> *[...] Some clinicians have not been trained in the uses of modern diagnostic technology*. Consequently, s*ome clinicians are accustomed to treating patients symptomatically since they were trained in an era with few diagnostic technologies available. Integrated Management of Childhood Illnesses (IMCI), which is symptom-based, is used most of the time [...]* (MO-2).

University of Ghana http://ugspace.ug.edu.gh

Furthermore, it was noted that certain diseases, such as opportunistic infections associated with HIV/AIDS like cryptococcal meningitis, SARS-related viral diseases such as Coronavirus Disease of 2019 (COVID-19), and hemorrhagic fevers such as Ebola, are of recent emergence. Unless clinicians from older generations have pursued continuous education to familiarize themselves with these new diseases, recent graduates who received training during periods of high prevalence of these diseases may possess greater ease in diagnosing these conditions:

> *[…] These days, more and more diseases are emerging. Now, someone who received training in 2018 might not be very familiar with COVID-19, but someone receiving training today is more likely to be, given that they are learning about it […] (*MO-3).

While certain diseases, such as tuberculosis, are not novel in the contemporary era, their understanding has significantly evolved over time. The comprehension of these diseases has been enriched with a substantial body of knowledge in recent years. Thus, clinicians who received their training in earlier times and have not been updated with these advancements may potentially misdiagnose these diseases:

> *[…] Some of our clinical officers cannot correctly diagnose HIV comorbidities. Clinicians who received their training in the 1990s cannot diagnose illnesses like Cryptococcal meningitis, Tuberculosis, and other HIV/AIDS comorbidities accurately, especially if they have not received refresher training since graduating from medical school. This is because, at the time of their qualification, such diseases were not adequately researched and documented […]* (MO-1).

The phenomenon of certain diseases becoming less common over time has implications for misdiagnosis mainly by recently qualified clinicians and trainees. These individuals may find it challenging to diagnose such diseases, unlike their senior colleagues who trained during a period when these diseases were more prevalent. Additionally, it is argued by the interviewees that contemporary trainees who overly depend on diagnostic technology or recent technological

University of Ghana http://ugspace.ug.edu.gh

advancements, rather than focusing on the presentation of the disease, may be at a disadvantage. This is particularly true in settings where hospitals lack adequate diagnostic tools:

> *[...] Clinical officers trained over two decades ago are accustomed to using the IMCI to treat patients symptomatically. They are unaware of the disease management techniques introduced [...]* (MO-6).

Relatedly, it has been observed that a number of senior medical practitioners may utilize the same Integrated Management of Childhood Illness (IMCI) guidelines, which are primarily designed for pediatric diseases, to assist in diagnosing adult patients. This practice is especially prevalent when the adult patient presents symptoms such as fever, cough, diarrhea, and respiratory distress.

Poor mentorship of clinicians in the diagnostic process

Senior clinicians and medical officers are expected to mentor and supervise junior clinicians and inexperienced health professionals, such as student clinicians and nurses. This is to ensure proper diagnosis by these individuals when it is unavoidable. On the other hand, some hospitals neglect to perform this crucial procedure.

> *[…] Some clinical training institutions simply send students to hospitals like this for practicum placements without providing an accompanying tutor to help them […]* (CO-1).

The problem is exacerbated by clinical rotation students who want to perform diagnoses in the outpatient department but only have theoretical knowledge and less practical experience. Trainee students often expect advice from on-duty clinicians. However, in the outpatient department, students often keep to themselves without mentors given the heavy workload at the OPD and emergency departments.

University of Ghana http://ugspace.ug.edu.gh

The clinician and patient ratio

The considerable patient load, particularly during daytime shifts, was a potential contributing factor to the incidence of misdiagnoses. This can be attributed to the insufficient number of clinicians available to manage the high volume of patients. Consequently, this results in an overwhelming workload, thereby increasing the likelihood of misdiagnosis:

> *[...] You know it might be one clinician working on hundred patients. When s/he gets tired, s/he will keep on 'saying another one, another one' without examining patients [...]* (CO-4).

Another interviewee mentioned high workload contributing to misdiagnosis of patients in the following way;

> *[…] Because of the high workload brought on by a large number of patients compared to the current diagnosticians, patients do not have enough time for a thorough history to be taken. Although there should be 12, they have only assigned six clinicians to this hospital. Otherwise, we will not be able to prevent the following syndrome […]* (CO-1).

The prioritization of reducing patient volume over comprehensive care in healthcare facilities may lead to a phenomenon referred to as the "next syndrome." This term is used to describe a common practice in outpatient departments where clinicians frequently usher in the subsequent patient shortly after briefly attending to the current one so as to reduce the number of patients in the queue. However, it may compromise the quality of care as the clinician might not conduct a thorough history-taking and physical examination due to time constraints.

The organization of human resources for duty

Patients may receive incorrect diagnoses if they are admitted by cadres inexperienced in diagnosing certain conditions. Patients may also be admitted without a functioning diagnosis pending expert consultation:

University of Ghana http://ugspace.ug.edu.gh

> *[...] A psychiatric and malnutrition diagnosis is not present in the majority of patients at admission. Even when such conditions coexist with others, they are rarely assigned right away. The admitting non-specialised clinicians may be reluctant to make diagnoses of such conditions because they are often diagnosed by specialists. Since the nutritionist and psychiatrist are not stationed at the OPD, admitting clinicians will likely have to wait for their opinions. Because there are not many of these patients present at the hospitals, specialists typically reserve their opinions for the patient's post-admission review. Furthermore, these specialists might not always be available at the hospital. What makes matters difficult is having one person for each specialty [...]* (MO-1).

An alternative viewpoint suggests that the likelihood of misdiagnosis may be associated with the tendency to entrust the care of patients with certain conditions solely to specialist clinicians. A case in point is that a patient whose diagnosis is exclusively under the care of a psychiatrist may be at risk of receiving an inaccurate psychiatric diagnosis. This is because the psychiatrist is likely to evaluate the patient primarily from a mental health perspective, potentially overlooking other non-psychiatric conditions or diseases that may be present:

> *[…] Health workers diagnose illnesses according to their training and specialization. When a medical officer reviews an admitted patient, you might discover that the person who admitted the patient—let's say a psychiatric nurse-would have made a different diagnosis if he or she had viewed the patient from a different perspective […]* (MO-5).

Many patients have received wrong diagnoses in such circumstances when they are reviewed.

4.3.1.7 Service Delivery and Misdiagnosis

This subsection presents an analysis of the influence of service delivery factors of the health system framework on misdiagnosis under four subthemes. These sub-themes include the referral system, laboratory systems and investigations, and history taking methods.

Referred Patients and Misdiagnosis

The qualitative inquiry further sought for explanations to why patients who were referred from lower-level health facilities in both private and public were likely to be misdiagnosed. A number

University of Ghana http://ugspace.ug.edu.gh

of issues were identified as likely reasons to this occurrence, including the misleading information that comes with referred patients, the possibility of initial misdiagnosis at the referring facility, and the failure of receiving clinicians to independently assess the patient's medical history. Further reasons given included the referring and receiving clinicians had the same level of disease comprehension.

Patients Mismanaged and Referred from Other Health Facilities

The interviewees expressed the view that a significant number of patients, particularly those referred from private clinics, presented complex treatment challenges upon their arrival at hospitals. They attributed this complexity to the subpar management of fever cases in these private clinics. Misdiagnoses, specifically that of malaria and enteric fever, were frequently observed in patients who were referred with a primary complaint of fever:

> *[…] Most fever patients referred from private clinics are not always simple to treat. The clinician's options for where to start are limited for someone who has already received quinine intravenously when they arrive […]* (CO-4).

Furthermore, it was mentioned that there is common practice for private clinics to initially diagnose cases of fever as either enteric fever or malaria. However, if the patient's condition does not improve under this preliminary diagnosis and treatment, the clinics then proceed to refer these patients to a hospital for further examination and care:

> *[…] The private clinics environment around the hospital encourages misdiagnosis, especially enteric fever. Clinicians who refuse to pause and consider their actions before acting fall into the same trap […]* (CO-5).

These results are in the assumption that a diagnostician at the referral hospital is likely to misdiagnose patients from those facilities if they choose to rely on their work rather than make their own diagnostic decisions.

University of Ghana http://ugspace.ug.edu.gh

Level of Diagnostic Comprehension Between Receiving and Referral Diagnosticians Affects Misdiagnosis

Patients referred from primary healthcare facilities are anticipated to receive superior and specialized treatment administered by highly skilled and experienced medical professionals. However, upon referral, the patient's initial care at the hospital is often provided by a clinician with potentially comparable training and experience to the referring clinician from the referring facility. Consequently, if the referral diagnosis is wrong, it is unlikely that it will undergo significant amendments, as both the referring and receiving clinicians may have a similar comprehension of the disease. This phenomenon could be another contributing factor to the misdiagnosis of referred patients:

> *[...] You probably know that the general hospital is an expansion of Health Center IV. When you come to the general hospital, you will find a clinical officer. This is the same experience you will have when visiting Health Center III, Health Center IV, or the hospital. If the clinicians at Health Centers III and IV miss the diagnosis, it is more likely that referred patients will encounter similarly qualified individuals from the same cadre at a general hospital who will also make the incorrect diagnosis. Do you comprehend? [...]* (MO-1)

Misleading Information with Referred Patients

The majority of the interviewees concurred that patients who are transferred from other healthcare facilities to hospitals often come with misleading referral information. This issue can be exacerbated if the clinician receiving the patient at the referral hospital has a personal or professional relationship with or trusts the individual or institution making the referral, leading to potential bias. If the clinician receiving the patient does not perform their own patient history and examination, they may be compelled to accept the referral information as accurate. Consequently, the initial diagnosis made at the time of referral may remain unchallenged and unchanged:

University of Ghana http://ugspace.ug.edu.gh

> *[…] In my opinion, it certainly has a lot to do with the patient's information. It's likely that the information a clinician receives about the patient will bias them, leading them to believe that the referral condition is more likely to exist than it would be if they had an index patient in their care who they could first fully assess […]* (MO-4).

Investigative results, including laboratory and sonographic findings, obtained from certain referring lower-level public health facilities and private clinics, often present inaccurate information. Sonography, a diagnostic procedure that employs high-frequency sound waves to image internal body organs, is a common source of such inaccuracies. The reliability and specificity of investigations conducted by private clinics have been questioned, leading to concerns that clinicians who depend on these results may make misdiagnosis:

> *[…] These patients occasionally present with laboratory and sonographic reports, which raise questions about their validity. Sonographers occasionally conduct ultrasound scans whose quality cannot be trusted. You receive a scan from a non-sonographer who has only recently learned the skill on the job. It perplexes me when the clinician also believes in the patient's incorrect sonographic report. When you examine this patient as a medical officer, you don't recognize any clinical signs that lend credence to the suggested diagnosis […]* (MO-5).

An additional concern identified pertains to the accuracy of diagnoses for patients referred from lower-level healthcare facilities. There appears to be a prevailing assumption among some clinicians that if a senior clinician from a lower-level health facility has made the referral diagnosis, it must be accurate. Consequently, the receiving clinicians often accept the referral diagnosis without conducting their own thorough review of the patient, which can lead to misdiagnosis:

> *[...] Some clinicians choose not to corroborate referral information when a patient is referred by a senior clinician from a lower-level healthcare facility. They continue to follow the referral diagnosis even if the referring clinician is mistaken. When the patient is examined later, a different condition is discovered than the one assigned in the referral or admission diagnosis [...]* (CO-4).

In certain instances, the healthcare professional making the referral may not necessarily hold a senior position. Despite this, primarily be due to time limitations, the receiving medical staff may

University of Ghana http://ugspace.ug.edu.gh

retain the referral diagnosis and proceed with the patient's admission based on potentially inaccurate referral information. At times, the diagnostician receiving the referral lacks the experience to validate the referral diagnosis, leading to a misdiagnosis:

> *[...] Experienced clinicians at lower-level healthcare facilities, are sometimes overworked with administrative tasks. As a result, health workers with less training, such as nursing assistants or inexperienced clinicians, manage and refer patients. If you, as the hospital's receiving and admitting clinician, fail to review the referral information, you run the risk of misdiagnosing the patient [...]* (CO-1)

There is a heightened probability of misdiagnoses when nursing assistants in lower-level healthcare facilities assume clinicians' roles, particularly in diagnosing and referring patients. This risk is further exacerbated if the referral diagnoses are accepted without scrutiny by clinicians at hospitals.

4.3.1.8 Laboratory and Radiological Investigations and Patient Misdiagnosis

Lack of access to investigations

Laboratory examinations and diagnostic imaging techniques are crucial in the diagnostic process, especially in confirming or ruling out suspected diseases. However, a significant number of respondents identified this step as contributing to misdiagnosis. This issue arises when the necessary investigations to substantiate the diagnosis are unable to be performed. The malfunction of certain testing equipment at critical times was cited as a contributing factor. For instance, the X-ray imaging machine, a key diagnostic equipment tool, was reported to occasionally be malfunctional, thereby hindering its use in supporting a diagnosis:

> *[…] A child may present with a fever and a cough. Based on a chest examination, TB or pneumonia are suspected. You would have loved to perform a chest X-ray to differentiate between those two, but the equipment is broken. Finally, you determine that the patient has pneumonia based on clinical symptoms and signs. Some of our patients are given false diagnoses just like that […]* (CO-3).

University of Ghana http://ugspace.ug.edu.gh

Such situations are partly responsible for misdiagnoses. This is especially true when clinicians treat patients based on their symptoms when tests or investigations should have been done to confirm or rule out a disease or condition.

Diagnosis Based on Clinical or Laboratory Tests

Whereas most participants emphasised the role of laboratory and imaging investigations in contributing to patients' misdiagnosis, the regression analysis of the quantitative findings revealed no significant relationship between making a diagnosis based on either clinical judgement or laboratory and imaging investigation with misdiagnosis. Some reasons have been given to expound on this finding.

Non-Adherence to Clinical History Taking and Examination

It was pointed out that undue reliance on laboratory and radiological investigations had a detrimental effect on the diagnostic process in that it causes diagnosticians to place little emphasis on the history-taking and physical examination phases of patient management. It was stated that investigations would only be beneficial if a thorough history was taken. In this case, the investigation is intended to serve as a confirmatory or disproving step in the diagnostic process. Additionally, it was emphasized that accurate history-taking, which in some cases might not have been done well as pointed out in this excerpt, was highly dependent on knowing the right investigations to make:

> *[…] Investigations are typically ordered to confirm or rule out a diagnosis. History-taking and physical examination usually contribute around 70% toward appropriate diagnostic decision making. Investigations may contribute around 30%. Therefore, the investigation might not substantially alter the diagnosis […]* (MO-1).

University of Ghana http://ugspace.ug.edu.gh

Although most clinicians request certain investigations, some may not be sufficiently skilled to interpret the results. This further explains why some patients' misdiagnoses have not been avoided even when investigations were carried out to guide the diagnostic process:

> *[…] You should not count on most clinicians to interpret tests like cell blood counts, kidney function tests, or X-ray findings in-depth […]* (MO-7).

The above scenario is more likely if the investigating officer does not include an interpretation report with the results, leaving it up to the ordering officer to interpret and make the diagnosis. On the other hand, some other diagnosticians might have routinely requested investigations, especially if they believed that the interpretation would ultimately be made by the medical officer who would review the patient on the ward. Therefore, even though the records may have shown that the investigation had been conducted at the time of admission, it is possible that the findings had no bearing on the diagnosis' final result, leading to the misdiagnosis.

4.3.1.9 **Medical technology and equipment and misdiagnosis**

This subsection examines how medical equipment and technology are associated with misdiagnosis and assisting in strengthening health facility management of ill health. The main technological components of the diagnostic process are diagnostic tests and diagnostic process support tools. Nevertheless, there was no correlation between the incorrect diagnosis and whether or not the patient's initial diagnosis was supported by further testing. This is supported by this study's quantitative results. However, some justifications were offered in the qualitative interviews to show how laboratory technologies impacted diagnosis.

University of Ghana http://ugspace.ug.edu.gh

The effectiveness of the diagnostic tests and misdiagnosis

Patients' misdiagnoses were also attributed to the ineffectiveness of certain diagnostic tests. Specifically, rapid diagnostic tests (RDTs) for malaria and peptic ulcer disease were singled out as having sensitivity and specificity issues, potentially leading to misdiagnoses. For example, some medical practitioners reported that RDTs for peptic ulcers demonstrated high sensitivity but low specificity. The interviewees acknowledged that, although these tests were initially developed for screening and not as confirmatory diagnostic tools, it is unfortunate that clinicians frequently depend on them for definitive diagnoses, despite their known limitations:

> *[…] I believe most of the time, the quality of the rapid diagnostic strips we are using is not acceptable because even if you pick up a child of two years waiting to be attended to outside with no complaints or signs of peptic ulcers and you check him using the H. pylori rapid diagnostic test strip, do not be surprised when they say that the H. pylori test is positive […]* (CO-1).

This claim thus revealed that some diseases would be misdiagnosed due to rapid diagnostic tests. False negatives resulting from the same RDTs may also not be excluded depending on the accuracy of these technologies, particularly their sensitivity or specificity.

4.3.1.10 Leadership, Governance and Organization of Care on Misdiagnosis

This section presents analysis of the leadership, governance and organization of care on misdiagnosis.

Managing Night admission of patients

The respondents were asked to explain the influence of night admissions on patient misdiagnosis. Several explanations were given in response to this question, including lack of access to examination and investigational tools, patient stabilization is the main priority at night,

University of Ghana http://ugspace.ug.edu.gh

and the fact that surgical, pregnancy, and accident-related diseases receive a lot of attention at night.

Management at night to stabilize patient

From the quantitative findings, patients admitted on the night shift had a higher chance of false diagnosis than those admitted on other duty shifts. This phenomenon can be attributed to the operational procedures adopted by the night shift clinicians. These clinicians often prioritize immediate patient stabilization, deferring comprehensive history-taking, physical examinations, and investigative procedures for accurate diagnosis to the daytime shift. This approach, while effective in immediate patient management, may contribute to an increased likelihood of initial misdiagnosis:

> *[…] We do not offer final diagnoses at night. We only stabilize that patient, and the following morning, we conduct thorough investigations and determine the patient's final diagnosis. You may discover that some cases lack a provisional diagnosis especially those at night […]* (MO-2)

As a result, one could either find no diagnosis at all assigned to the patient or a provisional diagnosis was assigned.

Absence of senior professionals to consult at night

Clinicians consult colleagues or someone more qualified than themselves—in this case, a medical officer if they cannot manage a case. However, this practice may not be possible at night, particularly with medical conditions.:

> *[…] There is a high chance that nighttime workers are more likely to make an incorrect diagnosis. One doctor is on duty at night, and his or her primary areas of interest are burns, accidents, and pregnant women. The majority of the cases you mentioned as the most frequently misdiagnosed involve internal medicine, which is probably not supported by medical officers at night. Therefore, a clinical officer*

University of Ghana http://ugspace.ug.edu.gh

> *who is unsure and wants to consult medical officers must wait until dawn […]* (MO-1).

With the above situation, misdiagnosis becomes inevitable since the clinician who is challenged on how to negotiate the diagnostic process has nobody else to consult to come up with the right diagnosis.

Lack of access to investigative and examination tools at night

At night, if a radiological investigation was needed to support a diagnosis, it was likely not to be done. Laboratories treat patients in emergency situations, such as hemorrhage victims or pregnant women, based on their context but rarely offer routine laboratory diagnostic service. Consequently, the laboratory will be on call for emergency related laboratory work and blood supply for anemic patients:

> *[...] During the night, the laboratory only performs the bare minimum of procedures, such as blood transfusions in emergencies. Since we do not have access to laboratory tests at night, we conduct our investigations in the morning to make a final diagnosis [...]* (CO-4).

It was also noted that in some hospitals, the difficulty of accessing examination equipment at night hampered efficient diagnostic procedures. Patients were not thoroughly examined due to a lack of equipment like the thermometers, pulse oximeter, stethoscope, and blood pressure machine, weighing scales, (use the equipment listed in the quotation). This is because the outpatient or emergency in-charges lock the aforementioned instruments in cabins at night:

> *[…] There is a locker where the thermometer, pulse oximeter, and blood pressure machine are kept. When you need them at night, they are locked there. Therefore, the clinician only relies on symptoms and physical signs to admit the patient without conducting a thorough examination. They discover that it was an incorrect diagnosis when they return and begin their investigation'* (CO-1).

This happening may also further explain why many of the patients who missed a provisional diagnosis may have been admitted at night.

University of Ghana http://ugspace.ug.edu.gh

Fatigued Clinicians working at night

Fatigue was mentioned in some explanations as another factor that contributed to patient misdiagnosis:

> *[…] Okay, at night, there is only one clinician on duty. This clinician is usually tired and will probably probe about the symptoms and signs but will not examine the patient […]* (CO-5).

4.3.1.11 Information, communication and technology

This subsection presents an analysis of the influence of leadership, governance and organization of care on misdiagnosis.

Patients misguiding clinicians

It has been argued that patients can sometimes lead clinicians astray while clinicians unknowingly allow themselves to be misled, which occasionally leads to misdiagnosis. For instance, some societies perceive treatment as not sufficiently effective if an injection is not given in a medical setting:

> *[…] As you know, if the case is not severe malaria, you do not administer intravenous artesunate. Nevertheless, this clinician may be persuaded to administer an injection to a patient by local "balalo" (cattle keepers') cultural beliefs that such patients require "kikato" (injection). Therefore, the clinician writes "severe malaria" to qualify this person for the desired treatment […]* (MO-1,).

Sometimes diagnosticians could be misled by highly informed patients, especially those with chronic conditions:

> '*Clinicians sometimes get confused by the patients who may have more information than what the clinician knows*' (MO-6 H2)

In this case, the patient may mislead the clinician into making a diagnosis, which ends up being a wrong one.

University of Ghana http://ugspace.ug.edu.gh

4.4 Situating the Study Findings in the Conceptual Framework

The conceptual framework in figure 2.2 outlines that the diagnostic process is involves going through a sequence of processes with the use of various structures to lead to desired outcomes. This requires the establishment of certain structures, referred to as inputs, such as patients, healthcare workers, diagnostic tools, and more. These inputs are influenced by both contextual and health system factors.

Contextual factors include the duration taken to examine a patient, the initial time the patient is seen, and the day of the week the patient is admitted. According to the study's findings, 90.8% of the patients were correctly diagnosed at the time of their hospital admission, while 9.2% were misdiagnosised. The results obtained satisfy the first objective of this study, which was to identify the extent of patient misdiagnosis in the hospital.

The prevalence of misdiagnosis called for the identification of related factors using both quantitative and qualitative methods. Consequently, several factors were found to be linked to misdiagnosis. These actions addressed objectives 3 through 6. These objectives included evaluating the relationship between factors related to diseases and the misdiagnosis of patients in Central Uganda's general hospitals, as well as investigating the link between factors related to patients and their misdiagnosis in these hospitals.

Patient-related factors, such as age and gender, also played a role. It was found that the likelihood of misdiagnosis increased with age. Similarly, being male was significantly linked to a higher chance of misdiagnosis. Patient misdiagnosis was found to be significantly linked to being referred from a lower-level health facility. The study findings indicated that the presence of multiple health conditions could lead to a higher chance of misdiagnosis as had been thought about in the

University of Ghana http://ugspace.ug.edu.gh

conceptual framework. Factors contributing to this increased risk of misdiagnosis included patient admission during the night shift, specifically between 10:00 pm and 8:00 am. Unlike previous studies that suggested a higher rate of misdiagnosis over the weekend, this study discovered no significant correlation between the day of the week a patient was admitted and the occurrence of misdiagnosis.

Objectives four and five examined the relationship between factors related to the health system and patient misdiagnosis in these hospitals and gained insight into the views of health workers on patient misdiagnosis. The study reveals that health workers' perceptions of misdiagnosis are influenced by their exposure to specific diseases and diagnostic technologies. Senior diagnosticians, lacking familiarity with contemporary technology, are prone to misdiagnosing conditions that necessitate the use of such technology. Conversely, junior clinicians may be more likely to misdiagnose diseases that are currently rare compared to their senior counterparts. Misdiagnosis is also likely when access to diagnostic technologies is hindered, either due to their absence from the hospital or their malfunctioning. The study further identifies a lack of collaboration and consultation within outpatient departments as a contributing factor to misdiagnosis.

As projected by the conceptual framework, the research demonstrated a direct correlation between the diagnostic process and misdiagnosis. This process encompasses the ordering and requesting of tests, the interpretation of results, the timeliness of results reception, and the utilization of these results. Instances where health workers are unable to interpret certain results, neglect to order necessary tests, or experience delays in receiving test results were identified as potential contributors to misdiagnosis. An over-reliance on tests, coupled with a disregard for intuition, was

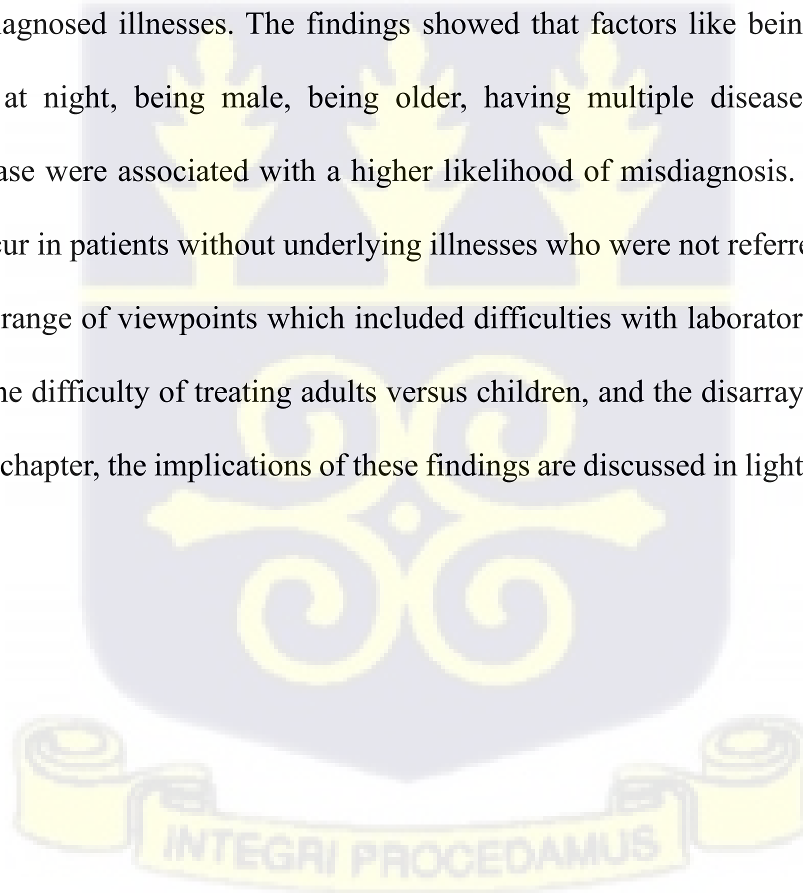
University of Ghana http://ugspace.ug.edu.gh

also perceived to precipitate misdiagnosis. Furthermore, the study found that inadequate information accompanying referrals could potentially lead to misdiagnosis.

The study findings validated the efficacy of the conceptual framework, which has been maintained in its original form.

4.5 Chapter summary

According to the study, 9.2% (223 out of 2431 patients) admitted to five hospitals were misdiagnosed. The majority (70.9%) of these patients with incorrect diagnoses fell under Class I. Peptic ulcer disease, severe malaria, hypertension, and other conditions were among the most frequently misdiagnosed illnesses. The findings showed that factors like being admitted to H2, being admitted at night, being male, being older, having multiple diseases, and having an uncommon disease were associated with a higher likelihood of misdiagnosis. Misdiagnosis was less likely to occur in patients without underlying illnesses who were not referred. The qualitative study covered a range of viewpoints which included difficulties with laboratory and radiological investigations, the difficulty of treating adults versus children, and the disarray of the night shift. In the following chapter, the implications of these findings are discussed in light of prior literature.



University of Ghana http://ugspace.ug.edu.gh

CHAPTER FIVE

DISCUSSION

5.1 Introduction

This chapter presents the discussion of the results. The meaning assigned to the findings and the conclusions made inform the recommendations that are suggested in the last chapter. The discussion is presented in sections related to the research objectives, that is, the proportion of patient misdiagnosis in hospitals, the classifications of patient misdiagnosis, and the environmental and health system factors associated with the misdiagnosis of patients in regard to the explanations to the observed association of the factors as pointed out by the health workers involved in patient misdiagnosis. The chapter ends with a summary that highlights the main achievements of the chapter are stated.

5.2 Outcome factors and Misdiagnosis

In this subsection, the findings are discussed with the outcomes defined in the Safer Diagnostic Framework (Sing &Sittig, 2015) derived from the Donabedian's model of quality of care (Donabedian, 1988). The framework posits that optimal diagnostic procedures should result in safer diagnostic outcomes and enhanced patient care. Nevertheless, the study reveals that this is not always the case. There are instances where suboptimal outcomes occur in certain patients, such as misdiagnoses. The primary themes that surfaced pertaining to outcomes are detailed in here.

5.2.1 The proportion of patient misdiagnosis

The results showed that 9.2% (95% CI: 8.1-10.3%) of the hospitalized patients were misdiagnosed. The findings suggest that one in every ten patients admitted had been initially been misdiagnosed at the point of admission in the outpatient or emergency department. The observed proportion of

University of Ghana http://ugspace.ug.edu.gh

misdiagnosis in this study was within the range of earlier studies (Graber, 2013b; Scott & Crock, 2020; Schiff et al., 2009).

While the general prevalence of misdiagnosis in settings comparable to those in Uganda is largely undetermined, past studies have indicated that the rate of misdiagnosis among hospitalized patients falls between 5% and 15% (Graber, 2013b; Schiff et al., 2009). However, there are disease specific misdiagnosis reported in Uganda settings. For example, in a study conducted in Uganda about malaria misdiagnosis, in over 39.9% of the children, malaria was misdiagnosed (Nankabirwa et al., 2009). Whereas the magnitude of misdiagnosis of patients in sub-Saharan Africa has until now remained unclear, the findings of this research rather delineate the extent of the problem in Ugandan general hospitals. The difference in the proportion of patients misdiagnosed in this study and those from other studies could be a result of the healthcare system differences, especially in the countries' disease patterns, studies' methodology, as well as the healthcare setup and organization, including the level of care where the studies were conducted (Singh et al., 2017a).

These findings epitomize that like in other healthcare systems where the diagnostic error has extensively been studied, misdiagnosis is a problem that could be affecting the quality of inpatient management in Uganda's hospitals. Diagnosis plays an important role in the choice of a patient's treatment plan, recovery, length of hospital stays, and the cost of health care among other outcomes (Wilson et al., 2012). The observed prevalence of misdiagnosis implies that there is quite a sizeable number of misdiagnosed patients who have to bear the challenges that follow misdiagnosis such as drug load associated with changes in the treatment plan, delayed recovery or death/disability (Mahumud, et al., 2016). In addition, there are those who may still incur additional costs not only

University of Ghana http://ugspace.ug.edu.gh

due to additional prescriptions but also due to prolonged hospital stay, disability or death (Zsifkovits et al., 2016).

5.2.2 Classification of patient misdiagnosis

The results of our study indicate that a substantial proportion of patients, 70.9% (95% CI: 64.9-76.9%), were initially misdiagnosed with a condition that falls under a different International Classification of Diseases, 11th Revision (ICD-11) major diagnostic grouping. This is referred to as a Class I misdiagnosis. This type of diagnostic error can lead to significant alterations in the management of the patient's condition, potentially resulting in financial implications for both the patient and the healthcare institution (NAM, 2015). Furthermore, if such misdiagnoses remain uncorrected, they could exacerbate the patient's health status or complicate their condition, leading to the inefficient use of resources and adverse outcomes for both the patient and the healthcare system (Singh et al., 2017).

5.2.3 The topmost ICD-11 major diagnostic groupings and diseases misdiagnosed

The Pareto analysis conducted demonstrated that a significant majority (80%) of misdiagnoses could be attributed to seven out of the 26 ICD-11major diagnostic groupings. Misdiagnoses were notably more frequent in seven major diagnostic groupings: disorders of the blood and blood-forming organs, certain infectious or parasitic diseases, circulatory system diseases, digestive system diseases, endocrine and nutritional disorders, respiratory system diseases, and musculoskeletal or connective tissue diseases. These results differ from findings in other health systems where an analysis of this kind was conducted. The findings here depict an increased scope (seven) of major diagnostic groupings under which misdiagnosis commonly occurs compared to the big three in the context of the United States where three major diagnostic groupings alone were

University of Ghana http://ugspace.ug.edu.gh

responsible for approximately three-quarters (74%) of all misdiagnoses (Newman-Toker et al., 2021).

A multitude of factors shape the regional variations in misdiagnosis rates. These include divergent disease prevalence, difference in healthcare access impacting contrarily on diagnostic outcomes, differences in medical training, and cultural influences collectively (Balogh et al., 2015). In addition, the characteristics of healthcare systems, including their strengths and weaknesses, also play a crucial role in influencing misdiagnosis rates (Singh et al., 2017). Some healthcare systems may demonstrate superior performance in diagnosing specific diseases due to their specialized focus on certain diagnostic groupings or resources used for diagnosis (Graber, 2013).

The present research identified a significant prevalence of misdiagnosis within two primary diagnostic categories: blood and blood forming organs and infectious or parasitic diseases. This pattern is consistent with observations in the United States (Newman-Toker et al., 2021). This can be attributed to the high prevalence of diseases within these groups and their often-non-specific symptoms, which can resemble other conditions (NAM, 2015). This underscores the complexity and challenges of accurately diagnosing diseases in these categories which increases the likelihood of a misdiagnosis (Singh, 2015). These findings highlight the need for a comprehensive approach to improving patient diagnosis rather than focusing exclusively on specific diseases. This approach is crucial given the global prevalence and complexity of infectious diseases and disorders related to the blood and blood-forming organs.

This research identified the diseases that are most frequently misdiagnosed, as well as quantifying the number of patients who received these incorrect diagnoses. The diseases identified included peptic ulcer disease, severe malaria, hypertension, pneumonia, gastroenteritis, enteric fever, and

University of Ghana http://ugspace.ug.edu.gh

pulmonary tuberculosis, among others. Additional conditions such as septicaemia, bacteraemia, anaemia, congestive cardiac failure, diabetes, stroke, chronic obstructive pulmonary disease, respiratory tract infection, cystitis, cryptococcal meningitis, and epilepsy were also noted.

Some of the most frequently misdiagnosed conditions in this study align with findings from a primary healthcare setting in Sweden, where the leading misdiagnosed diseases were reported to be cancer, heart disease, sepsis, pneumonia, and tuberculosis (Fernholm et al., 2019). However, with the exception of pneumonia, which is classified under certain infectious or parasitic diseases, the top misdiagnosed conditions in this study differ from those identified in other settings. For instance, a study conducted in the United States found that the most commonly misdiagnosed conditions were malignancies, pulmonary embolism, aortic aneurysms, and infections (Zwaan & Singh, 2020).

The divergence observed between the outcomes of this investigation and prior scholarly works may be ascribed to the contextual environment in which this research was undertaken, specifically within the confines of general hospitals. These hospitals function as intermediary primary healthcare facilities, where patients suffering from severe ailments, such as oncological conditions, are typically referred to more specialized healthcare units, which were not incorporated within the scope of this study.

In contrast, the most frequently misdiagnosed conditions identified in the research conducted by Zwaan and Singh (2020) were extrapolated from a diverse range of hospitals within the United States healthcare system. This underscores the significant impact that the healthcare setting can exert on the categorization of conditions that are most susceptible to misdiagnosis.

University of Ghana http://ugspace.ug.edu.gh

Furthermore, the disparities in misdiagnosis observed regionally among the primary diagnostic groupings in this study are also discernible when scrutinizing individual diseases. This suggests that the geographical location and the level of healthcare provision can significantly influence diagnostic accuracy (NAM, 2015; Singh, 2015).

The results of this study underscore the necessity for tailored approaches to address the issue of misdiagnosis, as opposed to the application of solutions that may be effective in other contexts. This is due to the potential variability in the leading misdiagnosed conditions and the subsequent underlying causes of misdiagnosis of these conditions, which necessitates a more specific health systems strategy (Newman-toker et al., 2021).

The majority (12/19) of the misdiagnosed conditions were common illnesses for which patients were admitted to the hospital, such as peptic ulcer disease, severe malaria, hypertension, gastroenteritis, pneumonia, urinary tract infection, enteric fever, tuberculosis, septicaemia, and bacteraemia. This is consistent with the findings of a Japanese study, which found that common chronic conditions were the leading cause of diagnostic errors in primary care settings (Aoki & Watanuki, 2020).

It was astounding that some of the most common misdiagnosed conditions, such as peptic ulcers, severe malaria, and pneumonia, had already received attention for improvement, such as the use of rapid diagnostic tests and hospital diagnostic regulations (Ministry of Health, 2014a). Despite these efforts, including medical education sessions aimed at improving malaria, pneumonia, anaemia, diabetes, and HIV diagnosis, misdiagnosis of these conditions persists. These measures have also included the use of rapid diagnostic tests, hospital diagnoses being regulated, and the

University of Ghana http://ugspace.ug.edu.gh

requirement of laboratory confirmation for malaria and peptic ulcer disease diagnoses (Kyabayinze et al., 2010; Ssebuliba et al., 2017).

The research outcomes indicate a potential incongruity between the established diagnostic policies for prevalent diseases in Ugandan hospitals and the actual implementation of these policies. This discrepancy could be attributed to the fact that these policies are primarily tailored for outpatient care, rather than inpatient care. Consequently, some hospitals have been unsuccessful in effectively executing the strategies intended to enhance diagnostic accuracy, potentially leading to misdiagnoses (Ssebuliba et al., 2017). For instance, the tuberculosis policy necessitates a gene-Xpert test for disease confirmation prior to initiating treatment, however, this protocol is not consistently adhered to (Nalugwa et al., 2020).

These findings further imply that either the diagnostic policies are not being appropriately implemented in Ugandan hospitals, particularly in the management of common diseases, or the policies themselves may not be suitable for inpatient care (Nalugwa et al., 2020). This may compel diagnosticians to admit patients with symptom-based diagnoses or assign diagnoses based on symptoms and signs without adhering to a standard work process for diagnostic adherence.

This study emphasizes the importance of improving the diagnostic process for multiple diseases rather than focusing solely on individual illnesses. Hospitals in Uganda and elsewhere should not be content with the status quo, especially for common conditions, in order to improve diagnostic accuracy (Car et al., 2016; Gill & Bailey, 2010; Hanscom et al., 2018; Ministry of Health, 2015b). This study suggests that implementing special tools or algorithms for diagnosis could help standardize and simplify the diagnostic process, particularly in outpatient settings.

University of Ghana http://ugspace.ug.edu.gh

The study findings suggest that it is important to consider misdiagnosis of all diseases, not just the most common ones, in efforts to improve the quality of diagnosis in Ugandan hospitals. While trivial many diseases may not frequently lead to patient admission and may not be top priority, they still have the potential to be misdiagnosed and have catastrophic consequences (Ivančić, 2014). Therefore, when planning measures to improve the quality of disease diagnosis, the impact of misdiagnosing these diseases should be considered (NAM, 2015).

5.3 Structure factors and Misdiagnosis

In this subsection, the findings of the study are examined and construed within the view of the sociotechnical component of the Safer Diagnostic and the health systems building frameworks (WHO, 2017). This section is firmly anchored in the structural constituents of the Donabedian model, which underpins the Safer Diagnostic Framework (Singh & Sittig, 2015). The focal point of this subsection is the discourse on the identified factors that precipitate misdiagnosis. These factors are split into three primary clusters: those pertinent to the disease, those affiliated with the patient, and those linked to the health system. This exhaustive analysis endeavors to furnish a profound comprehension of the intricacies implicated in diagnostic accuracy.

5.3.1 Disease-related factors and patient misdiagnosis

The study analyzed the relationship between a patient's number of illnesses and the likelihood of misdiagnosis, the relationship between misdiagnosis and multiple illnesses, concurrent illnesses, or a single illness. Patients with multiple illnesses were found to be 4.71 times ($p<0.01$) more likely to be misdiagnosed than those with a single illness. This research supports previous findings that link multiple illnesses to misdiagnosis (Aoki & Watanuki 2020; Panagioti et al., 2015). Previous research in Japan and elsewhere, for example, found that patients with multiple illnesses were 1.2 to 4.9 times more likely to experience a diagnostic error (Aoki & Watanuki, 2020).

University of Ghana http://ugspace.ug.edu.gh

Various studies have explained the difficulties in diagnosing patients with multimorbidity. Hausmann et al. (2019), found that diagnosticians may lack confidence when faced with patients with multimorbidity, leading to uncertainty and difficulty in coming up with a diagnosis. Diagnosing multimorbidity becomes challenging when the clinician is not familiar with the presentation of cases in patients with multimorbid conditions. The clinician may focus on the predominant complaints and overlook other covert signs, especially if the patient also has an underlying disease. When faced with challenging conditions, clinicians tend to focus on a condition they are familiar with. Gassmann et al. (2017), argue that diagnostic decision-making can be challenging because patients with multimorbidity seek treatment when they are critically ill, and their clinical history may have to be obtained from a surrogate who may not have much information. Similarly, Panagioti et al. (2015) stated that communication difficulties between multimorbid patients and clinicians are a factor in misdiagnosis. This is supported by Hausmann et al. (2019), who stated that when faced with patients with unrelated conditions, diagnosticians may be uncertain, making it difficult to make a diagnosis.

This study found that patients without underlying diseases were 37% less likely to be misdiagnosed compared to those with underlying diseases ($p=0.015$). Misdiagnosis can occur due to biases in the diagnostic process. For example, when a patient mentions an underlying disease, diagnosticians may focus solely on that and ignore other possibilities, leading to a misdiagnosis. On the other hand, if the underlying disease is not mentioned, the diagnostician may not consider it, even if it is the underlying cause. Hausmann et al. (2019) highlighted this as a potential source of ambiguity and misdiagnosis.

The present results offer major insights into the role disease-related factors play in influencing patient misdiagnosis. Two disease-related factors, that is; the presence of comorbidity and

University of Ghana http://ugspace.ug.edu.gh

multimorbidity were significantly found to be associated with patient misdiagnosis. Understanding these factors should be at the centre of patient diagnosis improvement in hospitals. Harrison et al. (2021) emphasized that at the various levels of health care, diagnosticians, and physicians will handle these two conditions in different ways hence influencing the healthcare delivered to patients with these conditions. For example, it is pointed out that at secondary health care delivery levels, the presence of another disease could arouse the notification of comorbidity by a specialist who will likely point out the disease of his or her specialty and others are considered as comorbidities (Marrie et al., 2009).

Harrison et al., (2021) have further argued that in instances where a patient presenting with multiple diseases seeks consultation at a primary health care center, it is observed that the attending general practitioner is inclined to attribute the patient’s visit to multimorbidity. This attribution persists even in cases where a single disease emerges as the primary reason for the patient’s utilization of the health care facility (Navickas et al., 2016). This demonstrates how the diagnostician's line of thinking and perception can contribute to misdiagnosis. These findings have important implications for developing guidelines for managing patients with multimorbidity and comorbidity, considering the patient's level of care.

5.3.2 Patient-related factors affecting misdiagnosis

The data indicated that patients aged 50 and above were 12.14 times more susceptible to misdiagnosis compared to their counterparts in the 0-9 age bracket. Furthermore, an increased likelihood of misdiagnosis was also observed in the age groups of 40-49, 30-39, 20-29, and 10-19 when compared to the 0-9 age group. These findings lend credence to the hypothesis that the probability of misdiagnosis escalates with age. The research conducted by Skinner et al. (2016) revealed a significant correlation between advanced age and the likelihood of misdiagnosis.

University of Ghana http://ugspace.ug.edu.gh

The qualitative aspect of the study suggested that the prevalence of multimorbid and comorbid diseases in older patients could potentially heighten their risk of misdiagnosis. This observation aligns with the findings of Singh (2016), which noted the typical presence of multiple medical conditions and organ failure in older patients. According to the World Health Organization (2018b), these factors can compromise other bodily systems, thereby complicating the diagnostic and treatment processes relative in older patients.

The results of the present study substantiate the hypothesis that significant deficiencies exist within the healthcare system, particularly in relation to the provision of medical services to the elderly population, with misdiagnosis being a contributing factor. The healthcare infrastructure in Uganda is inadequately prepared to cater for the needs of elderly patients, thereby escalating the probability of misdiagnosis. Maniragaba et al. (2019) underscored the scarcity of appropriate diagnostic devices in hospitals to manage diseases frequently observed in older patients. Concurrently, a systematic review conducted in low- and middle-income nations revealed that health workers perceived themselves as lacking the requisite qualifications to effectively treat elderly patients (Ssensamba et al., 2019).

Abudu-birresborn et al. (2019) have underscored the observation that health workers, specifically nurses, in low- to middle-income nations are inadequately equipped to provide care for the elderly population. This deficiency can be attributed to several factors, including a limited understanding of geriatric health, a reluctance to provide care for this demographic, and a prevailing negative perception towards them. Moreover, the absence of specialized geriatric practitioners in Ugandan hospitals underscores the urgent need for a heightened focus on geriatric care (Ssensamba et al., 2019).

University of Ghana http://ugspace.ug.edu.gh

Some health workers attribute diagnostic inaccuracies in geriatric patients to the provision of erroneous disease narratives during the medical history collecting phase. This perspective, however, may be rooted in an inherent bias against the elderly demographic, leading to a tendency among healthcare providers to dismiss their grievances (Ssensamba et al., 2019).

The process of aging can detrimentally affect a patient's cognitive faculties, manifesting in memory deterioration and communication challenges during the anamnesis, potentially leading to misconceptions and diagnostic errors (Skinner et al., 2016; Harada et al., 2013). Ayalon and Tesch-Römer (2018) posited that medical practitioners may exhibit impatience and lack of engagement with geriatric patients during consultations, or prematurely conclude cognitive impairment. Singh (2015) highlighted that elderly patients often present with non-specific symptoms that may obscure the root ailment, which could be misconstrued as dishonesty by health workers. Furthermore, the clinical examination of older patients can be complex due to the presentation of atypical symptoms compared to younger cohorts. This poses a challenge for diagnosticians who lack adequate preparation, thereby increasing the likelihood of diagnostic inaccuracies (Kostopoulou et al., 2008).

The research conducted by Zwaan et al. (2013) revealed a lower likelihood of misdiagnosis among pediatric patients aged 0-9 years compared to other age groups. This could potentially be attributed to the limited range of conditions that typically trouble this age group, which health workers are generally more familiar with. Furthermore, the focused efforts on enhancing pediatric healthcare, particularly for diseases prevalent among children such as malaria and pneumonia, may have played a significant role in this observed trend (Mbonye et al., 2014).

University of Ghana http://ugspace.ug.edu.gh

Children are predominantly escorted to healthcare facilities by women, who typically exhibit superior engagement with the healthcare system. This often results in the provision of comprehensive responses to inquiries and a detailed account of the child's symptoms, thereby facilitating more precise diagnostic decision-making (Hajjaj et al., 2010). The presumption that children are less susceptible to misdiagnosis, owing to the prevalence of their conditions among those frequently encountered by clinicians, is also a contributing factor (Mackian, 2003). Nevertheless, this perspective may explain why children are prone to misdiagnosis when they exhibit symptoms of conditions that are atypical for their age group (Epstein, 2019b).

The results of the study indicated a higher propensity for misdiagnosis in male patients, who were roughly twice as likely to experience this compared to their female counterparts. This contradicts prior research, which was primarily descriptive and suggested a higher likelihood of misdiagnosis in females (NAM, 2015; Newman-Toker, Moy, Valente, Coffey, & Hines, 2014). The current study's revelation of a higher misdiagnosis rate in males aligns with earlier research indicating poorer health outcomes for men (Baker, 2019). It has been observed that health systems have traditionally focused on improving health outcomes for children and women, which may inadvertently lead to a higher incidence of misdiagnosis among men and older patients (Nuzzo, 2020).

Health workers have identified several factors that contribute to the observed findings. One such factor is the tendency of men to seek medical attention late, often when their conditions have significantly deteriorated, thereby complicating the diagnostic process (Beia et al., 2021). Additionally, men often encounter difficulties in navigating the healthcare system's requirements for optimal diagnosis. These factors have been identified as contributing to the suboptimal health outcomes observed among males (World Health Organization, 2019).

University of Ghana http://ugspace.ug.edu.gh

Beia et al. (2021) further underscored the issue, noting that most health systems do not specifically target men's health. This lack of targeted attention results in men having limited health literacy and health-seeking behaviors. Consequently, men often report to hospitals late, when their conditions have significantly worsened, thereby increasing their risk of misdiagnosis. These observations raise critical questions about the approaches that health systems have adopted in the country with regard to improving men's health (Elterman & Pelman, 2014). It is imperative to address these issues to enhance health outcomes among the male population.

This study offers a novel viewpoint diverging from the conventional narratives presented in prior research (NAM, 2015). Several factors contribute to this divergence, including an amplified focus on maternal and child health, which may inadvertently influence the diagnosis of other diseases, as evidenced by improved diagnostic outcomes in children and females. While the primary focus on women's health is within the realm of maternal health, these services may indirectly enhance health-seeking behavior and expedite entry into healthcare systems for other medical conditions before they deteriorate (Olanrewaju et al., 2019). The proactive health-seeking behavior exhibited by women, which aids in streamlining the diagnostic decision-making process, confers a dual advantage to both women and children (Hajjaj et al., 2010). Furthermore, Hajjaj et al. (2010) posited that men might withhold pertinent information, which could otherwise be instrumental in diagnostic decision-making.

The qualitative analysis elucidated that, in contrast to their male counterparts who may exhibit reticence or potential duplicity in their engagement with diagnosticians, female patients tend to participate more actively in the diagnostic decision-making process. They do this by providing the necessary information to the diagnosticians in a more detailed manner. Even instances where they

University of Ghana http://ugspace.ug.edu.gh

divulge more information than solicited have proven to be advantageous in the processes of history-taking and diagnosis.

The findings of Elderkin-Thompson and Waitzkin (1999) are substantiated to a significant degree by this explanation. Their research articulates that female patients often disclose an abundance of information about their illnesses during history taking, some of which may be deemed superfluous and potentially perplexing to certain diagnosticians. However, for others, such information proved advantageous in the diagnostic decision-making process, particularly if they took the time to assimilate it. This concept was further elaborated by Levinson *et al*. (2004) and Plug et al. (2021), who posited that the diagnostician is likely to extract beneficial insights from the patient-diagnostician interaction amidst the seemingly excessive information disclosed by women. This contrasts with scenarios where minimal and non-revelatory information is provided, as is often the case with male patients.

Conversely, the potential correlation of male patients with diagnostic errors, as underscored in the qualitative analysis of this study, has been elucidated by prior research through various methodologies. Specifically, male patients are often perceived as less knowledgeable in healthcare environments compared to their female counterparts. When confronted with severe illnesses that require hospitalization, men, unlike women, are prone to display signs of naivety, anxiety, and uncertainty. This behavior may hinder their ability to effectively collaborate with diagnostic professionals, leading to the withholding of pertinent information that could significantly influence diagnostic decision-making (Hajjaj et al., 2010a; Harada et al., 2013). Consequently, this could result in the inability to gather sufficient patient history, which is crucial for making accurate diagnostic determinations.

University of Ghana http://ugspace.ug.edu.gh

This study has identified two primary patient-related factors that contribute to the misdiagnosis of patients. The research indicates that older patients have a higher likelihood of misdiagnosis compared to their younger counterparts. Additionally, the study found a significant association between male patients and the incidence of misdiagnosis, suggesting a higher prevalence compared to female patients. These findings underscore the necessity of incorporating a gender perspective in the development of strategies aimed at enhancing diagnostic accuracy. Specifically, these two factors significantly influence the type of information that healthcare workers prioritize during history taking and shape the manner in which they interact with patients during the diagnostic process. However, it is important to note that these findings may be influenced by a potential bias towards male behavior in health due to their traditionally poor interactions with the healthcare system, particularly in this region. Therefore, further research is warranted to validate these assumptions.

5.3.3 Health system-related factors and patient misdiagnosis

The preceding section predominantly focused on disease and patient-related factors contributing to misdiagnosis. This section, however, shifts the focus towards the role of health system factors in the occurrence of misdiagnosis. The outcomes observed are shaped by the processes and structure of the sociotechnical component of the Safer Dx framework derived from the Donabedian's model as well as the health systems building blocks (Singh &Siting, 2015; WHO, 2017). This section delves into the ways in which various components of the health system, either individually or collectively, are implicated in patient misdiagnosis. The discourse in this subsection is guided by the conceptual framework employed, particularly focusing on the connection between the structure and processes to the health system building blocks that influence the outcome of misdiagnosis (WHO, 2017).

University of Ghana http://ugspace.ug.edu.gh

5.3.3.1 Services delivery

The present investigation unveiled a lower likelihood of misdiagnosis among patients who had not been referred from primary healthcare facilities of a lower level, as compared to their referred counterparts (aOR=0.51; p=0.011). This observation aligns with the findings of prior studies, which reported a higher likelihood of misdiagnosis among referred patients (Bracho-Blanchet et al., 2014; Lighthall & Vazquez-Guillamet, 2015; Neshati et al., 2018). The primary factor contributing to this increased likelihood of misdiagnosis among referred patients was identified as cognitive bias. Specifically, clinicians receiving the patients were predisposed to concur with the diagnosis provided by the referring diagnostician (Lighthall & Vazquez-Guillamet, 2015). Consequently, in instances where the referring diagnostician's diagnosis was incorrect, the misdiagnosis was perpetuated if the initial diagnosis was maintained upon admission (Epner et al., 2013).

The problem of poor referral notes complicating the diagnosis of referred patients featured prominently. Similarly, Neshati et al. (2018) pointed out related concerns of poor referral notes that complicated the diagnostic decision making at the referred to health facilities. As it was pointed out in this study, this problem was particularly exacerbated when the referring health worker was low-skilled and the referral was taken without a thorough review of the patient (Bracho-Blanchet et al., 2014). This meant that the misdiagnosis might have actually commenced at the referral centre and later equivocally retained by the receiving clinician who accepts it without having made a thorough review and analysis of the patient.

Inextricably linked to the aforementioned point is the potential for misdiagnosis among referred patients due to reliance on potentially misleading investigations by clinicians. This presents a unique challenge that has yet to be thoroughly explored in existing literature. The issue is further

University of Ghana http://ugspace.ug.edu.gh

compounded by instances where referred patients have been subject to excessive management at lower levels, thereby complicating the diagnostic process for the receiving clinician. Additionally, the matter of patients being received by personnel possessing a similar level of expertise as the referring diagnostician should not be disregarded and warrants appropriate attention and resolution.

The findings of the over-dependence of clinicians on diagnostic investigations revealed two primary challenges. These challenges significantly impact cognitive processes, influencing the interpretation, comprehension, and understanding of patients' complaints and symptoms (Oyedokun et al., 2016). The first challenge is that an excessive reliance on investigations often results in inadequate attention to history taking and physical examination (NAM, 2015). This is evident when the progression of a patient's disease management halts due to negative or inconclusive test results for a previously suspected disease (NAM, 2015). Such a scenario suggests that a clinician may be inclined to make hasty and ill-considered diagnoses to expedite patient management, which may not be appropriate.

The second impediment arising from an excessive dependence on investigations for diagnosis is that when a diagnostician encounters a disease that lacks laboratory or radiological support, such a diagnostician, who is dependent on investigations, is prone to prematurely cease contemplation about the condition. If this medical practitioner also opts against consulting colleagues or utilizing diagnostic decision-making tools, they are likely to hastily dismiss the case and allocate minimal attention to the condition in question. As revealed in this study, previous researchers have warned about the potential for misdiagnosis due to poor interpretation of test results (Laposata, 2014; Nandini, 2016). Conversely, Neshati et al. (2018) underscored the issues related to the sensitivity

University of Ghana http://ugspace.ug.edu.gh

and specificity of certain tests, a concern that was prominently featured in the qualitative findings of this study.

This investigation into the service delivery component of the health system has yielded substantial insights into how the process aspect of the conceptual framework can contribute to diagnostic errors. The World Health Organization (2017) characterizes high-quality service delivery as the provision of prompt, superior, and safe services to those in need. However, evidence suggests that referred patients are more likely to be misdiagnosed, leading to substandard and unsafe care. Factors such as inadequate referral information and poor management of referred patients have been identified as potential contributors to this problem, thereby complicating the diagnostic decision-making process.

Moreover, the study reveals that patients who are excessively managed at lower-level facilities often encounter subpar diagnostic service delivery at the health facilities to which they are referred. The lack of sufficient referral information and poor patient management at subsidiary healthcare facilities undermine patient safety, credibility, and patient welfare. To enhance service delivery, reduce inefficiencies, and improve overall patient outcomes, it is imperative to refine referral procedures and improve the coordination between different levels of healthcare.

5.3.3.2. Leadership and governance

In the context of healthcare system, the mandate of leadership and governance is to implement administrative policies that bolster the safety and quality of diagnostic outcomes. The roles of leadership and governance encompass staff organization, policy formulation, and the cultivation of a culture prioritizing patient safety, among other responsibilities (WHO, 2017). This is particularly crucial for the efficacy of night shifts in hospitals, where the establishment of

University of Ghana http://ugspace.ug.edu.gh

organizational structures that are cognizant of the imperative to mitigate the risk of patient misdiagnosis is paramount.

Empirical evidence suggested a heightened prevalence of patient misdiagnosis during night shifts in comparison to other day shifts. This association between night shifts and patient misdiagnosis is primarily ascribed to the mode of operation and organization of services during these hours. According to the Safer Dx framework proposed by Singh & Sittig (2015), factors such as the configuration of care during night hours, the ambient conditions, and the necessary apparatus for healthcare delivery are classified under sociotechnical factors. Within the horizon of the health system framework, these components can be equated to governance and leadership.

The interactions between patients and health workers at night have been identified as a complex issue within numerous healthcare systems (Meyer & Naglak, 2020). This research highlights several factors that complicate these interactions, potentially leading to misdiagnosis. These factors include the unavailability of essential examination and diagnostic equipment such as thermometers, blood pressure monitors, and laboratory testing facilities. Additional challenges arise from the exhaustion of clinicians and the solitary nature of the diagnostic process, which leaves no room for consultation in the event of difficulties. Previous research has indicated a higher likelihood of errors among nursing staff during night shifts compared to day shifts, suggesting that factors such as fatigue, anxiety, and attention deficit can lead to a decrease in cognitive function and performance (Hughes, 2015; Lazzari et al., 2018).

Prior literature has underscored the complications associated with night duties, predominantly due to the inadequate structuring of these shifts, which increases the potential for diagnostic errors (Beglinger et al., 2015; Benavidez et al., 2014; Hamilton-fairley et al., 2014; Hughes, 2015;

University of Ghana http://ugspace.ug.edu.gh

Winters et al., 2012; Zwaan & Maude, 2016). The individuals tasked with diagnostic responsibilities during the night are often compelled to operate independently, devoid of consultation opportunities when confronted with difficulties, thereby increasing the likelihood of diagnostic inaccuracies (Meyer & Naglak, 2020). This rationale was echoed by several participants in the current investigation. The absence of physicians during night hours, leading to inadequate patient examination and review, has also been implicated in diagnostic errors (Beglinger et al., 2015).

In the medical facilities under investigation, the primary responsibility for diagnosis rested with the clinicians. However, in instances involving complex patient cases, the expectation was for these clinicians to seek guidance from senior colleagues or medical officers. Regrettably, the feasibility of consulting with medical officers during night shifts was often compromised, as they were predominantly occupied with surgical emergencies. This situation raises concerns about the structure of night shift duties, particularly in terms of fostering teamwork and collaboration among health workers (Beglinger et al., 2015).

Additionally, diagnostic processes are occasionally supplemented by laboratory and radiological investigations. However, interviewees highlighted the inability to perform laboratory investigations during night shifts as a significant obstacle to accurate diagnosis. This issue has been previously identified as a factor impeding proper diagnosis, primarily due to the logistical challenges associated with conducting tests during night shifts compared to day and evening shifts (Lam et al., 2020).

The study further elucidated those admissions occurring during nocturnal shifts predominantly involved severe cases in comparison to other shifts. These cases were often referrals from other

University of Ghana http://ugspace.ug.edu.gh

healthcare facilities, thereby creating a compounded predicament. The patients are likely to encounter health workers who may be experiencing fatigue and neurocognitive decline due to the late hours, potentially impairing their diagnostic decision-making abilities. This is particularly concerning for patients presenting with complex diseases during the night (Hamilton-fairley et al., 2014).

Additional research has highlighted the tendency of diagnosticians to deviate from established diagnostic procedures during night shifts, which could contribute to misdiagnosis (Besides, & Lazzari, 2018; Hamilton-fairley et al., 2014). This deviation may be attributed to the lack of supervision during these hours. Consequently, this could explain why some patients are assigned preliminary and inconclusive diagnoses during night shifts (Meyer & Naglak, 2020). Such diagnoses often require validation during the day shift, and any alterations to these initial diagnoses could result in instances of misdiagnosis. Therefore, the potential for misdiagnosis is heightened during night shifts due to a combination of factors including the severity of cases, the physical state of the health workers, and the lack of adherence to diagnostic procedures.

Previous studies have majorly posited that misdiagnosis and patient safety incidents are generally associated with weekend duty shifts compared to weekdays (Benavidez et al., 2014; Hoshijima et al., 2017; Mathew et al., 2018). However, in this study, there was no significant association recognized between misdiagnosis and patients having been admitted on either weekends or weekdays. This could be interpreted that in the hospitals studied, misdiagnosis was not influenced by the day of the week. The weekend shifts have hitherto had their challenges such as inadequate staffing and inadequate logistics (Sears et al., 2015). This thus provides some explanation as to why vigilance for quality diagnosis and measures for better diagnostic practices should be maintained on all days.

University of Ghana http://ugspace.ug.edu.gh

Alternative explanations may exist for the lack of observed correlation between patient misdiagnosis and weekend admissions, contrary to the majority of prior research (Hoshijima et al., 2017; Clinical Excellence Commission, 2015; Balla et al., 2012). During weekends, hospitals typically experience a reduced influx of patients. Consequently, the workload in the Emergency Department (ED) or Outpatient Department (OPD) is significantly lower compared to weekdays, with an average of 415 patients admitted on weekdays (Monday to Friday) and 227 patients on each weekend day (Saturday and Sunday) across the five hospitals studied. This reduced patient load provides health workers with sufficient time to adopt a more analytical approach when assessing patients, potentially enhancing their diagnostic accuracy.

Previous studies have suggested that patients admitted over the weekend are often in critical condition (Mathew et al., 2018). If this were the case in the hospitals under study, it is plausible that such patients were referred to higher-level hospitals for further treatment. Alternatively, these patients may have been among those who succumbed to their conditions, particularly if they were admitted under emergency circumstances, as supported by findings from another study (Hoshijima et al., 2017). However, it should be noted that the records of patients referred from the study hospitals and those of deceased patients were not included in this study.

5.3.3.3 Access to essential medical products, vaccines, and technologies

In the context of the World Health Organization's health system building blocks (WHO, 2017), and within the sociotechnical work system context of the Safer Dx framework (Singh's & Sittig, 2015), the primary focus of this research was on the accessibility of diagnostic technologies. This included investigations and patient examination tools such as thermometers, blood pressure monitors, and weighing scales, among others. These components form the structure within Donabedian's model (Donabedian, 1998), which is essential for conducting appropriate processes.

University of Ghana http://ugspace.ug.edu.gh

Consequently, an analysis was undertaken to determine whether the presence of laboratory or radiological investigation-backed diagnoses was associated with patient misdiagnosis.

The quantitative analysis conducted in this study demonstrated no correlation between the incidence of misdiagnosis and the utilization of laboratory investigations during the initial diagnosis. This suggests that there is no empirical evidence to substantiate the claim that the likelihood of misdiagnosis is influenced by the use of laboratory or radiological investigations at the time of the initial diagnostic decision.

The qualitative data, to a certain degree, substantiated the quantitative results, as the interviewees expressed divergent views on the significance of laboratory tests and radiological examinations in facilitating accurate diagnostic decision-making, thereby ensuring correct diagnosis of patients. Nevertheless, several obstacles associated with laboratory investigations were reported, which could potentially lead to misdiagnosis. For instance, some health workers indicated that diagnoses might have been inaccurate due to erroneous results possibly stemming from inaccurate rapid diagnostic tests, specifically those for peptic ulcers. Additional concerns were raised regarding potential inaccuracies in results due to malfunctioning diagnostic equipment.

Conversely, health workers identified the lack of laboratory and radiological examinations to corroborate the preliminary diagnosis as a potential factor contributing to the noted misdiagnosis in hospital settings. This is further compounded by delays in obtaining results for certain tests and the inability of clinicians to accurately interpret these results.

Previous research has underscored the complexities inherent in examinations and investigations of patients, which have been implicated in instances of diagnostic inaccuracies (Neshati et al., 2018; Wilson et al., 2018). Wilson et al. (2018) underscored the metaphorical laboratory deficiencies that

University of Ghana http://ugspace.ug.edu.gh

obstructed diagnostic decision-making processes. Neshati et al. (2018) drew attention to the challenges associated with the sensitivity and specificity of certain tests, an issue that also emerged in this study, albeit without any empirical substantiation. Other scholars have issued warnings regarding the misinterpretation of test results, which may occasionally lead to diagnostic inaccuracies (Laposata, 2014; Nandini, 2016). This factor was also identified by respondents as a contributing factor to some of the errors observed in this study. This could potentially clarify why, despite undergoing examinations, some patients were misdiagnosed, while others were admitted with diagnoses that merely indicated the patients' symptoms rather than providing a definitive or differential diagnosis.

5.3.3.4 Influence of human resources for health on misdiagnosis

This subsection offers an in-depth exploration into the domains where the competencies of clinicians have been associated with misdiagnosis. These domains encompass, but are not limited to, the management of patients presenting with multimorbidity, underlying conditions, and infrequent or rare conditions. Human resources for health constitute a pivotal element in both the Safer Dx framework and the health system building blocks, playing a crucial role in ensuring the provision of quality care (Singh & Sittig, 2015; WHO, 2017). Originating from Donabedian's 1998 model, which serves as the foundation for the Safer Dx framework, human resources are deemed a significant structural component that propels the majority of processes.

Despite the limitations of this study, primarily the lack of empirical data to substantiate the correlation between workload, work pressure, and misdiagnosis, the research provides several explanatories to the observed misdiagnosis burden. These explanations connect misdiagnosis to various factors associated with the health workers involved in the diagnostic process, including their qualifications, mentorship, training, and workload. In this study, a significant 90.8% of the

University of Ghana http://ugspace.ug.edu.gh

diagnoses were deemed accurate, suggesting a high level of diagnostic precision. This implies that the health workers involved demonstrated considerable competence, as evidenced by the high percentage of correct diagnoses.

Nonetheless, the interviewees expressed concerns regarding the proficiency of some diagnosticians stationed in the outpatient departments. This sentiment was predominantly voiced by the medical officers. This challenge usually happens with “high-end” diagnoses such as with complex patients with uncommon or rare diseases and those with comorbidities or underlying conditions. This perspective was predicated on the presumption that the clinicians’ training scope and knowledge base were insufficient for making diagnoses of such magnitude.

The aforesaid perspectives are corroborated by other scholars in this field, as evidenced by studies examining the diagnostic decision-making abilities of mid-level health workers in other health systems (Couper et al., 2018; Giorgio et al., 2020). A study utilizing clinical vignettes, conducted across ten Sub-Saharan African nations that included Kenya, Madagascar, Mozambique, Nigeria, Niger, Senegal, Sierra Leone, Tanzania, Togo, and Uganda where mid-level healthcare workers oversee diagnostic decision-making, revealed that these practitioners correctly diagnosed 64% of cases, albeit with significant disparities among countries (Giorgio et al., 2020). However, a notable limitation of the study’s methodology was its failure to account for contextual factors that could influence diagnostic decision-making in real-world scenarios. Conversely, an analysis of the curriculum and training requirements of mid-level healthcare workers involved in diagnostic processes in four African nations, including Uganda, Nigeria, South Africa, and Kenya, found that the majority of the training only encompassed 50% of the potential real-world scenarios these healthcare workers might encounter (Couper et al., 2018).

University of Ghana http://ugspace.ug.edu.gh

The above-mentioned perspectives have been corroborated in other studies, notably in the United Kingdom where physician assistants have asserted that their training has adequately equipped them to manage patients with less severe medical conditions (Drennan et al., 2015). The same review further highlighted that the course curricula predominantly focused on conditions that the health workers were likely to encounter in their professional practice. Drawing parallels with the findings of the present study, it can be inferred that the misdiagnosis of rare conditions could potentially be attributed to the inadequate preparation of clinicians during their education to accurately diagnose challenging and uncommon diseases or conditions.

While the diagnosticians have been deemed deficient in their ability to make suitable diagnostic determinations in the face of complex and rare diseases, it is crucial not to overlook the potential influence of various contextual factors that could impact their neurocognitive functioning in outpatient departments or emergency rooms. Considerations such as workload and work-related stress, the urgency required in initiating treatment, fatigue during certain times of the day, and previously noted challenges associated with investigations, among others, should be taken into account when assessing the diagnosticians' proficiency in making more accurate and safer diagnoses of high-end conditions.

The process of diagnosing diseases can pose significant challenges, even for the most proficient diagnosticians, particularly in high-pressure environments such as outpatient or emergency departments (NAM, 2015). The complexity of patient cases often necessitates the use of an analytical approach to diagnostic decision-making (NAM, 2015). However, the demanding nature of these departments, especially during day and evening shifts, may preclude the application of this method (Hughes, 2015). An analytical approach involves a time-consuming process that requires collaboration with team members, ordering, conducting, receiving, and interpreting the

University of Ghana http://ugspace.ug.edu.gh

results of laboratory and radiology investigations to make an informed decision (O'Daniel & Rosenstein, 2008a). However, the conditions and contexts under which diagnostic processes are conducted in emergency departments may not always permit such comprehensive procedures (Caterino & Stevenson, 2012). Consequently, clinicians may resort to using a more expedient heuristic approach, which increases the likelihood of misdiagnosis (Berner, 2017).

Furthermore, the team responsible for reviewing patients on the ward is obligated to employ an analytical approach during their evaluation. This is in contrast to the clinicians at the Outpatient Department (OPD) and Emergency Department (ED), who may not have the same luxury. The ward provides a serene environment conducive to thorough examination, devoid of the haste often experienced at the OPD and ED (O'Daniel & Rosenstein, 2008a). If similar conditions were present at the OPD and ED during initial diagnosis, it is plausible that the diagnostic approach and outcomes might vary.

The urgency to initiate treatment promptly in order to alleviate a patient's distress at the time of initial diagnosis may induce diagnosticians to formulate a preliminary diagnosis, which is often derived heuristically (Peng et al., 2015). This contrasts with the ward reviewers who establish the final diagnosis through a process of collective, collaborative, and corroborative decision-making. A diagnostician, particularly in the context of an Outpatient Department (OPD) or Emergency Department (ED), may not have the same opportunity due to the constraints of the clinical setting and the immediate needs of the patient (Croskerry et al., 2017). For the diagnostician providing the initial diagnosis, the alleviation of the patient's discomfort and emotional distress may supersede the precision of the diagnosis (Hofmann & Hinton, 2014).

University of Ghana http://ugspace.ug.edu.gh

In relation to the issue of staffing levels and the incidence of misdiagnosis, the majority of interviewees posited that the current staffing levels were insufficient to adequately manage the existing workload. In certain hospitals where misdiagnosis was notably prevalent, the scarcity of clinicians was identified as the primary factor contributing to the issue. The problem of understaffing was reported in the majority of the hospitals, with the actual number of staff falling short of the established staffing norms.

The increased workload experienced by diagnosticians can lead to a detrimental impact on their concentration and performance, thereby increasing their susceptibility to errors (Zwaan et al., 2009). The high workload conditions often result in diagnosticians allocating less time for patient interaction, which subsequently limits the extent of patient history acquisition and examination. This could potentially result in the omission of crucial information required for accurate diagnostic decision-making. Conversely, an extremely low work volume could potentially compromise proficiency, as might be the case during nocturnal hours (Wong et al., 2015). The phenomenon known as the “next syndrome” exemplifies the tendency of diagnosticians to expedite patient treatment in an effort to alleviate their workload. This speedy approach could potentially precipitate inaccuracies in diagnostics.

Within the healthcare system of Uganda, it has been observed that the volume of work tends to peak during day shifts, particularly on Mondays and Tuesdays, while the workload is typically lower on weekends and during night shifts (Katende et al., 2015). Nonetheless, no significant correlation was identified between the day of the week and the occurrence of misdiagnosis. Consequently, it would be inappropriate to infer a connection between misdiagnosis and the days when the workload is assumed to be high. Furthermore, no empirical investigations were conducted to quantify the exact workload and work pressure at the time of patient admission, which

University of Ghana http://ugspace.ug.edu.gh

could have provided a more concrete basis for the interviewees' perceptions. Remarkably, night shifts, which are generally associated with a lower volume of work, were found to have a higher incidence of misdiagnosis. A variety of factors unrelated to work pressure have been extensively examined to elucidate this association.

5.4 Chapter summary

This chapter has discussed what the study achieved through responding to the research questions and objectives and the relationship between the current results and previous literature. The findings have been discussed within the conceptual framework chosen which is a synchronization of the safer dx framework and the health systems building blocks (Singh & Sittig, 2015; WHO, 2017). It has further synthesised and interpreted the findings as well as the key conclusions and the implications of the findings for future research. The results further reveal that when improving the quality of diagnosis within the hospitals, it is necessary to consider the health system factors that could affect disease-specific misdiagnosis or be cognizant of the factors that may broadly affect the misdiagnosis of many conditions. There could be common contributions to the misdiagnosis of diverse conditions or diseases and these should be considered while designing quality diagnosis improvement strategies. The next chapter provides the summary of the study, conclusion, recommendations, contributions of the study, study limitations, and recommendations for future research.

University of Ghana http://ugspace.ug.edu.gh

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the summary of the study findings, contribution to knowledge, conclusions, recommendations, and limitations of the study. The direction for future research has also been presented here.

6.2 Summary of the study

The objective of the study was to determine the extent of misdiagnosis among patients in general hospitals in Central Uganda. The study collected data from patients' records and health workers/diagnosticians in selected hospitals in Central Uganda using a sequential mixed-methods approach. To determine the proportion of misdiagnosis, diagnostic decisions made by clinicians and diagnosticians were compared with diagnostic decisions ratified by medical officers and physicians on the ward upon discharge as reasons for major treatment.

Misdiagnosis was classified into four distinct classes namely from Class I to Class IV. The Pareto principle was employed as a methodological tool to discern the diseases most frequently subject to misdiagnosis. Logistic regression was used to analyze the factors associated with misdiagnosis, with variables with statistical significance ($p\text{-values} < 0.05$) and their adjusted odds ratios considered independently associated. In-depth interviews were undertaken with a cohort of eight clinical officers and seven medical officers to glean insights into the prevalence of misdiagnosis within the hospital setting.

The general findings were that 9.2% of the patients had been misdiagnosed among the 2,431 patients, with 70.9% falling into Class I, indicating differing major diagnostic groupings. The

University of Ghana http://ugspace.ug.edu.gh

major diagnostic grouping where most misdiagnoses are found is the group certain infectious or parasitic diseases (32%). Most misdiagnoses (82.9%) are non-communicable diseases. Factors such as male gender, night admission, admission to H2, having multimorbidity, having an uncommon illness and age over 50 were significantly associated with misdiagnosis.

The factors contributing to patient misdiagnosis are consistent with the principles of the Safer Diagnostic Framework and the fundamental components of a health system. The lack of knowledge among clinicians about rare diseases is a reflection of the challenges faced by the health workforce. The difficulty in diagnosing certain demographic groups underscores the necessity for healthcare services that are specifically designed to meet their needs. The shortcomings observed in laboratory and radiological tests are indicative of infrastructure inadequacies.

The organization of nighttime services and fatigue among healthcare workers was deemed to be inefficient contributing to misdiagnosis bringing attention to issues related to governance and human resources management. Limitations in service delivery, health information, workforce, and clinical support have a significant impact on the patient referral process contributing to misdiagnosis. The difficulties encountered in managing health information, workforce-related issues, and inadequate investigations are signs of deficiencies in technological and clinical support services, which affect the diagnosis of patients who have been referred.

6.3 Conclusion of the study

This section presents the conclusion based on the specific objectives of the study, which were; To determine the proportion of misdiagnosis among patients admitted in general hospitals in Central-Uganda; To classify the conditions being misdiagnosed in the general hospitals in Central Uganda; To assess the association between disease-related factors and patient misdiagnosis in general

University of Ghana http://ugspace.ug.edu.gh

hospitals in Central Uganda; To examine the association between patient related factors and patient misdiagnosis in general hospitals in central Uganda; To assess the association between health system related factors and patient misdiagnosis in general hospitals central Uganda; and To explore health workers' perspectives of patient misdiagnosis in general hospitals in general hospitals in Central Uganda.

The study concludes that the proportion of inpatients misdiagnosed at admission was 9.2%. The rate of wrong medical diagnoses in the Ugandan hospital studied as revealed in this is 9.2%, which is within the global average of 5–15% (Schiff et al., 2009). This means that almost 1 out of every 10 diagnoses could be incorrect. This implies some patients' safety is still endangered which may lead to eroded trust in healthcare, strained resources, rise in legal concerns and potential threats to public health (NAM, 2015). This emphasizes the urgent need for healthcare system enhancements, increased research, and ongoing education to enhance diagnostic accuracy.

The study found out that the majority of patients with misdiagnoses (70.6%) were categorized as Class I misdiagnoses, indicating that the initial diagnosis(es) at the time of admission and the final diagnosis(es) belonged to different major diagnostic groups. According to this classification, the initial treatment recommended at admission will likely have to be modified due to a diagnosis change. This extent of misdiagnosing patients could potentially affect the level of trust patients have in the healthcare system and their willingness to follow prescribed treatment plans (Suzuki et al., 2021). Such types of misdiagnoses contribute to an increase in healthcare expenses due to the administration of unnecessary treatments (Kirch & Scafii, 1994). Such misdiagnoses can result in treatment delays and the exacerbation of medical conditions (Mahumud, et al., 2016).

The most frequently misdiagnosed conditions fall into seven broad diagnostic groups. These include certain infectious or parasitic diseases; diseases of the digestive system; diseases of the

University of Ghana http://ugspace.ug.edu.gh

circulatory system; endocrine, nutritional, or metabolic disorders; diseases of the genitourinary system; diseases of the respiratory system; and diseases of the blood and blood-forming organs. The conditions that are frequently misdiagnosed, as identified in this study, are consistent with the findings of existing literature. It has been observed that approximately 40% of severe outcomes are a consequence of diagnostic errors pertaining to conditions such as stroke, sepsis, pneumonia, venous thromboembolism, and lung cancer (Newman-Toker, 2023). The aforesaid conditions can be classified into three primary categories: circulatory system disorders, infectious or parasitic diseases, and respiratory system ailments as those in this study. This underscores the intricacies involved in accurate diagnosis of these diagnostic groups.

The top 19 most frequently misdiagnosed diseases were almost evenly split between common and uncommon hospital admission conditions. Peptic ulcer diseases, severe malaria, hypertension, pneumonia, gastroenteritis, enteric fever, and pulmonary tuberculosis are among these illnesses. Septicemia, bacteremia, anemia, congestive heart failure, diabetes mellitus, stroke, chronic obstructive pulmonary disease, respiratory tract infection, cystitis, cryptococcal meningitis, and epilepsy are among the other conditions. Findings are consistent with those by Haddad et al., (2021) where most infections as listed here were listed among the most misdiagnosed including cryptococcal meningitis and respiratory tract infections. This underscores the need to improve diagnosis of these conditions especially those of infectious origin since they are common.

Non-communicable diseases (NCDs) make up the majority of wrong diagnoses. Non-communicable diseases, including heart diseases, lung diseases, and diabetes, are complex with many causes and a wide range of symptoms making them difficult to diagnose (Habib and Saha, 2010). The problem is worse in places where there is no much access to healthcare, and where

University of Ghana http://ugspace.ug.edu.gh

there are minimal ways to screen for these diseases and detect them early (Luna and Lucykx, 2020). Correspondingly, it can be even more difficult to make an accurate diagnosis of non-communicable diseases because they can have symptoms that mimic other diseases, (Chen et al., 2023). This highlights the need for better ways to screen for and detect these diseases, as well as improved access to healthcare.

The disease-related factors associated with misdiagnosis include being treated with an uncommon condition only, a patient having a known underlying disease by the time of admission and having been treated for multimorbidity (three or more diseases).

6.4 Contribution of the study

The thesis makes significant contributions in three key areas: theory, methodology, and policy. The study integrated the Safer Dx and the World Health Organization health systems frameworks to develop a conceptual model for understanding diagnostic errors. In terms of theory, this provides a new approach through which misdiagnosis can be viewed, studied and addressed.

By using the novel ICD-11 system and the impact of misdiagnosis on treatment and patient outcomes to classify the extent of misdiagnosis, the study methodologically provides a nuanced approach to classifying diagnostic errors different from the Goldman autopsy classification. By doing so, the research demonstrates it does not have to wait for death to happen to study diagnostic errors to drive quality improvement in lower-level hospitals. This also shifts the focus from resource-intensive autopsies which are also not available at all healthcare system levels to more feasible records review that can be applicable at all healthcare system levels.

On the policy front, the thesis advocates for the formulation of a comprehensive strategy and the development of a specific policy addressing diagnostic errors which is non-existent. This

University of Ghana http://ugspace.ug.edu.gh

reinforces the need for a robust diagnostic error policy to mitigate risks and improve healthcare outcomes.

6.5 Recommendations of the study

This section presents recommendations based on the findings for consideration by stakeholders in the health environment. Having been conducted at mid-level healthcare system facilities in Uganda, this study gives insights into what the challenges of diagnostic error(s) could be in primary healthcare facilities. The findings of this study, therefore, have important implications for policymakers, specifically the Ministry of Health, the management of the hospitals, and medical training schools as demonstrated below.

Policymakers at the Ministry of Health

Policymakers in Uganda should consider exploring the development of guidelines for the assessment and management of patients with multimorbidity. Findings from this study along with insights from previous research by Mickesifield et al., (2023) highlight that multimorbidity may contribute to diagnostic errors. However, to inform the development of such guidelines, additional research in form of longitudinal studies or systematic reviews are recommended so as to better understand the specific challenges and effective strategies for overcome diagnostic errors among patients with multimorbidity.

Where possible, policymakers and hospital managers should consider developing and piloting electronic diagnostic algorithms to support the diagnostic procedures in outpatient and emergency settings. However, this is recommended to first be carried out on a small scale in few health facilities to evaluate possibility and effect of leading to better diagnostic outcomes before scaling up to a larger scale.

University of Ghana http://ugspace.ug.edu.gh

It is important for policymakers to reflect on addressing the challenges of diagnosis in elderly patients. However, to realise this, it is recommended to first conduct cohort studies as a way of further exploring diagnostic challenges in elderly populations so as to better to inform evidence-based policymaking.

The findings of this study highlight the importance of health policymakers in Uganda prioritizing men's health. Based on the insights gained from this study as regards why men are more prone to misdiagnosis, a particular emphasis should be placed on encouraging men to seek health care early (Beia et al., 2021). Additionally, improving men's health and health-seeking behaviors could be instrumental in improving their suboptimal diagnostic outcomes. Another potential strategy might involve encouraging men to accompany their wives to their antenatal care appointments so they can be screened for specific illnesses at specialized medical clinics. Health education during antenatal care visits has been shown to increase male participation in other clinical decision-making processes in other contexts (Chiang & Shorey, 2023). The provision of healthcare that is sensitive to the unique needs and challenges of men could significantly reduce the barriers that contribute to poor health-seeking behavior, which has been identified as a factor in the misdiagnosis of men.

The referral system in Uganda has been identified in this study as facing significant challenges, particularly in terms of uncoordinated communication contributing to patient misdiagnosis. Similar concerns have been brought forward in previous research (Turyamureba et al., 2023). Consequently, several recommendations applicable to this study based on the findings have been proposed (Mugisha, 2018). These include considering the development of an efficient information system and implemented at both the referring and receiving health facilities to coordinate referrals.

University of Ghana http://ugspace.ug.edu.gh

Additionally, it is suggested that health workers should receive training on making effective referrals, including instruction on guidelines for managing and conducting referrals. The design of a standard referral toolkit to monitor the referral system has also been recommended. These guidelines should be disseminated to all health workers. It is further proposed that standard referral forms be designed to capture the necessary information for an effective referral system. This strategy should aid in enhancing referral communication and feedback mechanisms. The proposed communication strategy should incorporate referral data collection systems, analysis, and utilization of the information.

Identify innovative ways tailored to specific healthcare systems or hospital contexts to enhance clinicians' cognitive abilities. Professional development and education have a significant role to play in the healthcare sector, especially when it comes to treating rare diseases (Smith, 2020). Ensuring that health workers are aware of the latest research findings on diagnostic and therapeutic innovations is crucial to staying up-to-date with the field (Pontis et al., 2017). These approaches should aim to bolster diagnostic reasoning, particularly in cases involving diagnosing uncommon or rare medical conditions.

To the hospital managers/Management of Hospitals

There is a need for considering quality improvement initiatives be conducted in Ugandan hospitals, particularly within emergency and outpatient departments. It may be helpful to initiate patients' evaluation especially those with complex health conditions and those referred in at the point of admission (POA), rather than doing so when admitted at the ward. Additionally, having a medical officer available at the emergency or outpatient departments for immediate consultation on complex outpatient cases could improve continuity of care. This approach could address the

University of Ghana http://ugspace.ug.edu.gh

current practice observed in four of the five hospitals where the outpatient department manages both roles.

Instituting night management programmes by hospital managers is recommended including proper night duty scheduling, staff allocation, staff coordination, and ensuring the provision of the necessary tools required for apposite patient diagnosis. Effective night management in hospitals is vital for patient safety, recovery, and critical care. Night shift staff contribute uniquely to patient safety; while addressing challenges faced by night workers is crucial for patient well-being and optimal critical care (Hamilton-Fairley et al., 2014). To overcome this challenge, hospital managers can institute sleep routines, foster supportive work relationships, and maintain a healthy work-life balance for their staff. Similarly, managers should ensure that health workers utilize breaks wisely, plan meals, optimize their sleep environment, and minimize overstimulation for better sleep. During the night, it is advisable to minimize tasks that require complex expertise and leave complex tasks to experts (Hamilton-Fairley et al., 2014).

Improving access to appropriate laboratory and radiological investigations as well as improving the skills of the clinicians to timely and appropriately interpret the results. This can be done by ensuring that point of care investigation is accessible to clinicians, especially for tests using rapid diagnostic tests.

Clinicians should receive on-job training in the interpretation of laboratory and radiological investigations, especially the modern methods that clinicians are not familiar with. It is vital to keep up with the latest developments because of the rapid pace of progress in patient care. Diagnosticians in this case the clinicians need to understand new ways of diagnosing illnesses to provide the best care for their patients (Kasten, 2020). This includes correctly interpreting

University of Ghana http://ugspace.ug.edu.gh

laboratory tests and radiology results to make accurate diagnoses. Knowing how to read these test results helps them plan effective treatments and improves their ability to communicate with patients. Engaging in ongoing professional learning helps clinicians advance in their careers and deliver high-quality healthcare (Abbott et al., 2014).

Hospitals are encouraged to embrace diagnostic error-guided training, especially for resident clinicians and student interns. The training could either be on the job through continuous medical education and by the routine ward rounds or at points of admission of patients when the opportunity arises.

Hospital leaders should prioritize reducing diagnostic errors as a key strategy to improve overall hospital quality. This is crucial for building a trustworthy and safe reputation, ensuring patient confidence, and fostering a culture that prioritizes preventing diagnostic mistakes (NAM, 2015).

To the healthcare workers

Concerted efforts are needed to ensure better management of patients with complex conditions such as those with comorbidities and with underlying diseases. Health workers are encouraged to promote a collegial and collaborative culture of patients' diagnosis rather than being individually handled as is usually the practice (Hackmann, 2019).

Commonly misdiagnosed conditions should take priority when improving diagnosis. Prioritizing commonly misdiagnosed conditions is crucial because they pose a higher risk of patient harm due to their frequency. By addressing these prevalent errors, healthcare systems can have a more significant impact on overall diagnostic accuracy, patient safety, and quality of care (NAM, 2015).

University of Ghana http://ugspace.ug.edu.gh

Health Training Schools/Institutions

The need to train clinicians on how to anticipate, diagnose and manage patients with whom certain factors were associated with misdiagnosis as observed in this study were likely to manifest/be recommended. This aligns with previous literature emphasizing the importance of training clinicians to anticipate, diagnose, and manage patients linked to factors contributing to misdiagnosis (NAM, 2015)). In the short term, in-service training for practicing health workers in geriatrics and geriatric care could be considered to reduce the problem of misdiagnosis and improve the overall management of older patients.

6.6 Further Research

It is recommended that a related study in hospitals at a higher level of the healthcare system should be undertaken When it is feasible, research at higher levels of care should use autopsy findings as a benchmark for analyzing misdiagnoses. This will provide rich and complete picture of diagnostic errors. Future investigations into misdiagnosis costs and their effects on healthcare delivery are recommended

6.7 Limitations to the study

The present research, although insightful, had some methodological constraints. It was conducted in general hospitals that usually treat less complex medical cases compared to regional or referral hospitals that deal with more severe cases. This could potentially lead to an underestimation of misdiagnosis rates. However, these general hospitals serve a large portion of the country's patient population, making the findings valuable. The insights gained could help improve patient safety in primary healthcare settings, benefiting a substantial part of the population.

University of Ghana http://ugspace.ug.edu.gh

The potential for having obtained different results exists if the referred patients were not omitted. This is so because it is possible to underestimate misdiagnosis rates by excluding referred patients from the records finally considered for review since they often present complex cases with multiple risk factors. In the absence of this information, the results may appear skewed, potentially giving the impression that there are fewer misdiagnoses. In addition, because mid-level hospitals vary in their characteristics and referral patterns, it becomes difficult to generalize the findings of this study to regional referral hospitals.

The study's findings may have been influenced by the precision of the records used. The inherent limitations of paper-based records, including manual data entry and the absence of standardized recording procedures, could have introduced inaccuracies or incompleteness in the patient records. The exclusion of these records from this study may have resulted in an inaccurate estimation of the prevalence of patient misdiagnosis. Furthermore, the manual coding process and susceptibility to human error can introduce data entry inaccuracies, potentially affecting the identification of misdiagnosed patients or some of the variables investigated thus potentially distorting the study's findings.

The strict criteria for inclusion and exclusion could have led to inaccuracies in representing the extent of misdiagnosis. Consequently, the prevalence of misdiagnosis might have been either overestimated or underestimated.

The declaration of a lockdown following COVID-19's second wave (Ministry of Health, 2021b) made it extremely difficult to contact some of the participants chosen for the qualitative interviews. Due to the fact that only in-person interviews received ethical approval, attempts to contact these

University of Ghana http://ugspace.ug.edu.gh

participants online were unsuccessful. Nevertheless, because the interviews had become saturated, no more fresh information could be gleaned from them.

The lack of data on diagnosticians' characteristics placed limits on the study. This was primarily due to diagnosticians not signing off on patient forms. Additionally, because the study was conducted in fewer hospitals, information could only be obtained from a small number of health professionals. This would make it statistically impossible to increase a sufficiently large sample size. Besides, due to the difficulties in figuring out the diagnosticians who had admitted the patient, these variables had to be dropped even though it had been originally planned to include them. However, the qualitative findings serve to address this gap and give in-depth insights to human resources for health gaps that affect misdiagnosis.

University of Ghana http://ugspace.ug.edu.gh

REFERENCES

Aase, S. (2013). Autopsy – still the gold standard? *Tidssk Nor Legeforen*, 133(7), 730–731.

Abbott, M., Paulin, H., Sidhu, D., & Naugler, C. (2014). Laboratory tests, interpretation, and use

Abe, T., Tokuda, Y., Shiraishi, A., Fujishima, S., Mayumi, T., Sugiyama, T., Deshpande, G. A.,

Abimanyi-Ochom, J., Bohingamu Mudiyanselage, S., Catchpool, M., Firipis, M., Wanni Arachchige Dona, S., & Watts, J. J. (2019). Strategies to reduce diagnostic errors: a systematic review. *BMC Medical Informatics and Decision Making*, *19*(1), 1-14.

Abiy, R., Gashu, K., Asemaw, T., Mitiku, M., & Fekadie, B. (2018). A comparison of electronic medical record data to paper records in antiretroviral therapy clinic in Ethiopia: What is affecting the quality of the data? *Online Journal of Public Health Informatics*, 10(2), e212. https://doi.org/10.5210/ojphi.v10i2.8309

Adler, N. E., & Newman, K. (2002). Socioeconomic disparities in health: Pathways and policies. Health Affairs, 21(2), 60–76. https://doi.org/10.1377/hlthaff.21.2.60

Akachi, Y., & Kruk, M. E. (2017). Quality of care: measuring a neglected driver of improved health. *Bulletin of the World Health Organization*, 95(6), 465–472. https://doi.org/10.2471/blt.16.180190

Akanbi, M. O., Ocheke, A. N., Agaba, P. A., Daniyam, C. A., Agaba, E. I., Okeke, E. N., & Ukoli, C. O. (2012). Use of electronic health records in sub-Saharan Africa: progress and challenges. *Journal of Medicine in the Tropics*, *14*(1), 1–6.

University of Ghana http://ugspace.ug.edu.gh

Alam, R., Cheraghi-sohi, S., Panagioti, M., Esmail, A., & Campbell, S. (2017). Managing diagnostic uncertainty in primary care: a systematic critical review. *BMC Family Practice,* 18(1), 79. https://doi.org/10.1186/s12875-017-0650-0

Alexoaie, S. C., Costache, D. V., & Mihaescu, T. (2016). Mastering the art of conversation in pediatrics: A key in reducing diagnostic errors. *Diagnosis,* 3(2), eA34. https://doi.org/http://dx.doi.org/10.1515/dx-2016-0015

Alotaibi, Y. K., & Federico, F. (2017). The impact of health information technology on patient safety. *Saudi Medical Journal*, *38*(12), 1173.

Ashton, C. M., Kuykendall, D. H., Johnson, M. L., & Wray, N. P. (1999). An empirical assessment of the validity of explicit and implicit process-of-care criteria for quality assessment. *Medical Care, 37*(8), 798–808.

Avelino-Silva, J. T., & Alan, S. M. (2020). Diagnostic discrepancies between emergency department admissions and hospital discharges among older adults: Secondary analysis on a population-based survey. *Sao Paulo Medical Journal, 138*(5), 359–367. https://doi.org/10.1590/1516-3180.0471.R1.05032020

Awaisu, A., Mukhalalati, B., Izham, M., & Ibrahim, M. (2019). Research Designs and Methodologies Related to Pharmacy Practice. *Encyclopedia of Pharmacy Practice and Clinical Pharmacy*, 7–21. http://dx.doi.org/10.1016/B978-0-12-812735-3.00602-6

University of Ghana http://ugspace.ug.edu.gh

Ayatollahi, H., Bath, P. A., & Goodacre, S. (2009). Paper-based versus computer-based records in the emergency department: Staff preferences, expectations, and concerns. *Health Informatics Journal, 15*(3), 199–211. https://doi.org/10.1177/1460458209337433

Ba, R. Z., Frosch, D. L., Kuzemchak, M. D., & Politi, M. C. (2014). Physicians' perceptions of shared decision-making behaviours: a qualitative study demonstrating the continued chasm between aspirations and clinical practice. *Health Expectations, 18*(6), 2465–2476. https://doi.org/10.1111/hex.12216

Balla, J., Heneghan, C., Goyder, C., & Thompson, M. (2012). Identifying early warning signs for diagnostic errors in primary care: A qualitative study. *BMJ Open, 2*(5), 1–9. https://doi.org/10.1136/bmjopen-2012-001539

Balogh, E. P., Miller, B. T., Ball, J. R., & National Academies of Sciences, Engineering, and Medicine. (2015). Technology and tools in the diagnostic process. In *Improving Diagnosis in Health Care*. National Academies Press (US).

Banks, J. N. (1998). Designing medical record abstraction forms. *International Journal for Quality in Health Care, 10*(2), 163–

Bhardwaj, P. (2019). Types of sampling in research. *Journal of Primary Care Specialties*, *5*(3), 157-163.

Beglinger, B., Rohacek, M., Ackermann, S., Hertwig, R., Karakoumis-Ilsemann, J., Boutellier, S., Geigy, N., Nickel, C., & Bingisser, R. (2015). Physician's first clinical impression of

University of Ghana http://ugspace.ug.edu.gh

emergency department patients with nonspecific complaints is associated with morbidity and mortality. *Medicine*, 94(7), e374. https://doi.org/10.1097/MD.0000000000000374

Beia, T., Kielmann, K., & Diaconu, K. (2021). Changing men or changing health systems? A scoping review of interventions, services and programmes targeting men's health in sub-Saharan Africa. *International Journal for Equity in Health*, 20(1), 1–16. https://doi.org/10.1186/s12939-021-01428-z

Benavidez, O. J., Gauvreau, K., & Geva, T. (2014). Diagnostic errors in congenital echocardiography: Importance of study conditions. *Journal of the American Society of Echocardiography*, 27(6), 616–623. https://doi.org/10.1016/j.echo.2014.03.001

Berenson, R. A., Upadhyay, D. K., & Kaye, D. R. (2014). Placing diagnosis errors on the policy agenda: Timely analysis of immediate health policy issues (Issue 2).

Berner, E. S., & Graber, M. L. (2008). Overconfidence as a Cause of Diagnostic Error in Medicine. *The American Journal of Medicine*, 121(5A), S2–S23. https://doi.org/10.1016/j.amjmed.2008.01.001

Bernheim, S. M., Ross, J. S., Krumholz, H. M., & Bradley, E. H. (2008). Influence of patients' socioeconomic status on clinical management decisions: A qualitative study. *Annals of Family Medicine*, 6(1), 53–59. https://doi.org/10.1370/afm.749

Beronson, R., & Singh, H. (2018). Payment innovations to improve diagnostic accuracy and reduce diagnostic error. *Health Affairs*, 37(11), 1828–1835. https://doi.org/10.1377/hlthaff.2018.0714

University of Ghana http://ugspace.ug.edu.gh

Berta, W., Barnsley, J., Bloom, J., Cockerill, R., Davis, D., Jaakkimainen, L., Marie, A., Yves, M., & Vayda, E. (2008). Enhancing continuity of information: Essential components of a referral document. *Canadian Family Physician*, 54, 1432–1433.

Bhaskar, R. (2008). A Realist Theory of Science. Routledge Taylor & Group.

Bhattacharyya, S., Kaur, R., Kaur, S., & Ali, S. A. (2017). Validity and reliability of a questionnaire: a literature review. *Chronicles of Dental Research*, 6(2), 17–24.

Birks, Y., Aspinal, F., & Bloor, K. (2018). Understanding the drivers of litigation in health services. *Report. UK: University of York and the King's Fund*.

Blewett, L. A., Call, K. T., Turner, J., & Hest, R. (2018). Data Resources for Conducting Health Services and Policy. Annual Review of Public Health, 39, 437–452.

Brabers, A. E. M., Rademakers, J. J. D. J. M., Groenewegen, P. P., Van Dijk, L., & De Jong, J. D. (2017a). What role does health literacy play in patients' involvement in medical decision-making? PLoS ONE, 12(3), 1–12. https://doi.org/10.1371/journal.pone.0173316

Bracho-Blanchet, E., Cazares-Rangel, J., Zalles-Vidal, C., & Davila-Perez, R. (2014). Misdiagnosis and quality of management in paediatric surgical patients referred to a tertiary care hospital. Journal of Clinical and Diagnostic Research, 8(4), 1–5. https://doi.org/10.7860/JCDR/2014/7988.4241

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

University of Ghana http://ugspace.ug.edu.gh

Browne, B. K., Roseman, D., Shaller, D., & Edgman-levitan, S. (2010). Measuring Patient Experience as A Strategy for Improving Primary Care. *Health Affairs*, 29(5), 921–925.

Bruce, E. S., & McDonald, J. (2007). The Measurement of Health Care Performance: A primer from the Council of Medical Specialty Societies. Chicago, Illinois: Council of Medical Specialty Societies

Buyego, P., Nakiyingi, L., Ddungu, H., Walimbwa, S., Nalwanga, D., Reynolds, S. J., & Parkes-Ratanshi, R. (2017). Possible misdiagnosis of HIV associated lymphoma as tuberculosis among patients attending Uganda Cancer Institute. *AIDS Research and Therapy*, 14(1), 10–15. https://doi.org/10.1186/s12981-017-0148-9

Carapinha, J. L., Ross-degnan, D., Desta, A. T., & Wagner, A. K. (2011). Health insurance systems in five Sub-Saharan African countries: medicine benefits and data for decision making. *Health Policy*, 99(3), 93–202. https://doi.org/10.1016/j.healthpol.2010.11.009

Carter, J., Muller-Stover, I., Ostensen, H., & Heuck, C. Chr. (2005). *Good clinical diagnostic practice: a guide for clinicians in developing countries to the clinical diagnosis of disease and to making proper use of clinical diagnostic services*. World Health Organization Regional Office for the Eastern Mediterranean.

Cashin, C., Chi, Y. L., Borowitz, M., & Thompson, S. (2014). *EBOOK: Paying For Performance in Healthcare: Implications for Health System Performance and Accountability*. McGraw-Hill Education (UK).

University of Ghana http://ugspace.ug.edu.gh

Caterino, J. M., & Stevenson, K. B. (2012). Disagreement Between Emergency Physician and Inpatient Physician Diagnosis of Infection in Older Adults Admitted from the Emergency Department. *Academic Emergency Medicine*, 19(8), 908–915. https://doi.org/10.1111/j.1553-2712.2012.01415.x

Cesare, N., & Were, L. P. O. (2022). A multi-step approach to managing missing data in time and patient variant electronic health records. *BMC Research Notes*, 15(64), 1–7. https://doi.org/10.1186/s13104-022-05911-w

Chatterjee, S., Ray, K., & Das, A. K. (2016). Gap analysis between provisional diagnosis and final diagnosis in government and private teaching hospitals: A record linked comparative study. *Journal of Family Medicine and Primary Care*, 5, 637–640. https://doi.org/10.4103/2249-4863.197318

Chen, X., Zhou, S., Wang, Y., Zheng, L., Guan, S., Wang, D., ... & Guan, X. (2023). Nanopore single-molecule analysis of biomarkers: Providing possible clues to disease diagnosis. *TrAC Trends in Analytical Chemistry*, 117060.

Cheraghi-Sohi, S., Singh, H., Reeves, D., Stocks, J., Rebecca, M., Esmail, A., Campbell, S., & Wet, C. De. (2015). Missed diagnostic opportunities and English general practice: a study to determine their incidence, confounding and contributing factors and potential impact on patients through retrospective review of electronic medical records. *Implementation Science*, 10(1), 105. https://doi.org/10.1186/s13012-015-0296-z

Chiang, R. K. Q., & Shorey, S. (2023). Men's experiences of antenatal care services in low-income and middle-income countries: A qualitative systematic review. *Birth*, *50*(2), 276-286.

University of Ghana http://ugspace.ug.edu.gh

Chodos, J. E. (2015). Should there be specialty courts for medical malpractice litigation? *Columbia Medical Review*, 1(1), 10–22. https://doi.org/10.7916/D8SF2V8B

Chowdhury, S. A., & Habib, L. (2015). Improved documentation and record management: A necessity to prevent medical errors in health care system. *International Journal of Medical Science*, 2(11), 1–3.

Clinical Excellence Commission (2015). *Diagnostic Error: Learning Resource for Clinicians*. Sydney, Clinical Excellence Commission.

Cooper, J., Williams, H., Hibbert, P., Edwards, A., Butt, A., Wood, F., Parry, G., Smith, P., Sheikh, A., Donaldson, L., & Carson-Stevens, A. (2018). Classification of patient-safety incidents in primary care. *Bulletin of the World Health Organization*, 96(7), 498–505. https://doi.org/10.2471/BLT.17.199802

Creswell, J. W. (2007). *Research design: qualitative, quantitative and mixed method approaches.* California: SAGE Publications. https://doi.org/10.4135/9781849208956

Creswell, J. W. (2007a). Qualitative inquiry and research design: Choosing among five approaches (2nd ed., Vol. 2). SAGE Publications. https://doi.org/10.1016/j.aenj.2008.02.005

Creswell, J. W. (2013). Steps in Conducting a Scholarly Mixed Methods Study. DBER Speaker Series 48. https://digitalcommons.unl.edu/dberspeakers/48.

Creswell, J. W. (2014). Research design: qualitative, quantitative, and mixed methods approach (4th ed.). Los Angeles: SAGE Publications.

University of Ghana http://ugspace.ug.edu.gh

Creswell, J. W. (2014). The Selection of a Research Approach. In J. W. Cresswell (Ed.), Research design: qualitative, quantitative and mixed methods approach (4th ed., I, pp. 3–23). Los Angeles. Sage.

Croskerry, P., & Nimmo, G. R. (2011). Better clinical decision making and reducing diagnostic error. *Journal of the Royal College of Physicians of Edinburgh, 41*(2), 155–162. https://doi.org/10.4997/JRCPE.2011.208

Cruickshank, J. (2012). Positioning positivism, critical realism and social constructionism in the health sciences: A philosophical orientation. *Nursing Inquiry, 19*(1), 71–82. https://doi.org/10.1111/j.1440-1800.2011.00558.x

Daniel, P., Bewick, T., Welham, S., Mckeever, T. M., & Shen, W. (2017). Adults miscoded and misdiagnosed as having pneumonia: results from the British Thoracic Society pneumonia audit. *Thorax, 72*(4), 376–379.

Das, J., Woskie, L., Rajbhandari, R., Kamran, A., & Ashish, J. (2018). Rethinking assumptions about delivery of healthcare: implications for universal health coverage. *BMJ, 361*, k1716. https://doi.org/10.1136/bmj.k1716

Davis, D. L., Mulligan, M. E., Moszkowicz, A., & Resnik, C. S. (2017). Clinical history provided by referring clinicians and patients for musculoskeletal MRI. *Journal of the American College of Radiology, 14*(9), 1215–1218.

de Lusignan, S., Sadek, N., Mulnier, H., Tahir, A., Russell-Jones, D., & Khunti, K. (2012). Misclassification and misdiagnosis. *Diabetes & Primary Care, 29*(1), 181–189.

University of Ghana http://ugspace.ug.edu.gh

de Moissac, D., & Bowen, S. (2019). Impact of Language Barriers on Quality of Care and Patient Safety for Official Language Minority Francophones in Canada. *Journal of Patient Experience, 6*(1), 24–32. https://doi.org/10.1177/2374373518769008

Derlet, R. W., Mcnamara, R. M., & Kazzi, A. A. (2014). Emergency department crowding and loss of medical licensure: A new risk of patient care in Hallways. *Western Journal of Emergency Medicine, 15*(2), 137–141. https://doi.org/10.5811/westjem.2013.11.18645

Dingley, C., Daugherty, K., Derieg, M. K., & Persing, R. (2008). Improving Patient Safety Through Provider Communication Strategy Enhancements. In *Advances in Patient Safety*.

Dong, D., Yat, R., Chung, N., Chan, R. H. W., Gong, S., & Xu, R. H. (2020). Why is misdiagnosis more likely among some people with rare diseases than others? Insights from a population - based cross - sectional study in China. *Orphanet Journal of Rare Diseases*, *15*(1), 1–12. https://doi.org/10.1186/s13023-020-01587-2

Dowhaniuk, N. (2021). Exploring country-wide equitable government health care facility access in Uganda. *International Journal for Equity in Health, 20*(1), 1–19. https://doi.org/10.1186/s12939-020-01371-5

El-Kareh, R., Hasan, O., & Schiff, G. D. (2013). Use of health information technology to reduce diagnostic errors. *BMJ Quality and Safety, 22*(Suppl 2), 40–51. https://doi.org/10.1136/bmjqs-2013-001884

Ely, J. W., Kaldjian, L. C., & Alessandro, D. M. D. (2012). Diagnostic Errors in primary care: Lessons learned. *JABFM, 25*(1), 87–97. https://doi.org/10.3122/jabfm.2012.01.110174

University of Ghana http://ugspace.ug.edu.gh

Epner, P. L., Gans, J. E., & Graber, M. L. (2013a). When diagnostic testing leads to harm: a new outcomes-based approach for laboratory medicine. *BMJ Quality& Safety 22*(Suppl 2), ii6–ii10. https://doi.org/10.1136/bmjqs-2012-001621

Epstein, H. M. (2019a). The most important medical issue ever: And why you need to know more about it. *Diagnosis*. https://www.improvediagnosis.org/dxiq-column/most-important-medical-issue-ever/

Epstein, H. M. (2019b). Why your child is more likely to be misdiagnosed than you are. *Dx IQ No. 3: Be Informed and Prepared for Every Medical Interaction*. https://www.improvediagnosis.org/dxiq-column/why-your-child-is-more-likely-to-be-misdiagnosed-than-you-are/

Ericsson, K. A. (2008). Deliberate practice and acquisition of expert performance: A general overview. *Academic Emergency Medicine, 15*(11), 988–994. https://doi.org/10.1111/j.1553-2712.2008.00227.x

Fares, A. F., Cury, P. M., & Lobo, S. M. (2011). Clinical-pathological discrepancies in critically ill patients with difficult premortem diagnoses. *Revista Brasileira de Terapia Intensiva, 23*(4), 442–447. http://www.ncbi.nlm.nih.gov/pubmed/23949457

Fatima, S., Shamim, S., Butt, A. S., Awan, S., Riffat, S., & Tariq, M. (2021). The discrepancy between admission and discharge diagnoses: Underlying factors and potential clinical outcomes in a low socioeconomic country. *Plos One*, *16*(6), e0253316

University of Ghana http://ugspace.ug.edu.gh

Foot, C., Naylor, C., & Imison, C. (2010). The quality of GP diagnosis and referral. An Inquiry into the Quality of General Practice in England. *The King's Fund*. LondonT

Gallant, I. J. S., Keita, G. P., & Royak-Schaler, R. (1997). Gender differences in patient-physician communication. In *Health care for women: Psychological, social, and behavioural influences* (pp. 57–71). American Psychological Association.

Gara, M. A., Minsky, S., Silverstein, S. M., Miskimen, T., & Strakowski, S. M. (2019). A naturalistic study of racial disparities in diagnoses at an outpatient behavioral health clinic. *Psychiatry Services, 70*(2), 130–134.

Garada, R. (2015). Rethinking modern sociological theories: An analytical synthesis of their ontology, epistemology and methodology. *Global Journal of Human-Social Science: Sociology & Culture, 15*(1), 42–54.

Ghai, R. R., Thurber, M. I., El Bakry, A., Chapman, C. A., & Goldberg, T. L. (2016). Multi-method assessment of patients with febrile illness reveals over-diagnosis of malaria in rural Uganda. *Malaria Journal, 15*(1), 1–6. https://doi.org/10.1186/s12936-016-1502-4

Ghooi, R. B., & Deshpande, S. R. (2012). Patients' rights in India: an ethical perspective. *Indian Journal of Medical Ethics, 9*(4), 277–281. https://doi.org/10.20529/ijme.2012.092

Gibson, T. N., Shirley, S. E., Williams, E. W., Rhudd, A., French, S., & Hibbert, R. (2017). Discrepancies between clinical and autopsy diagnoses in the emergency department of the university hospital of the West Indies. *West Indian Medical Journal, 66*(2), 311–317. https://doi.org/10.7727/wimj.2015.192

University of Ghana http://ugspace.ug.edu.gh

Gillon, S. A., & Radford, S. T. (2012). Zebra in the intensive care unit: A metacognitive reflection on misdiagnosis. *Critical Care and Resuscitation, 14*(3), 216–221.

Goggins, K. M., Wallston, K. A., Nwosu, S., Schildcrout, J. S., Castel, L., & Kripalani, S. (2014). Health literacy, numeracy, and other characteristics associated with hospitalized patients' preferences for involvement in decision making. *Journal of Health Communication*, 19(2), 29–43. https://doi.org/10.1080/10810730.2014.938841

Good, M. D., James, C., Good, B. J., & Becker, A. E. (2005). The culture of medicine and racial, ethnic, and class disparities in healthcare. *The Blackwell Companion to Social Inequalities. Malden, MA: Blackwell Publishing, Ltd*, 396-423.

Gosden, T., Forland, F., Is, K., Sutton, M., Leese, B., Giuffrida, A., Sergison, M., & Pedersen, L. (2006). Capitation, salary, fee-for-service and mixed systems of payment: effects on the behaviour of primary care physicians (Review) (CD002215; *Cochrane Database of Systematic Reviews* 2000, Issue 3). https://doi.org/10.1002/14651858.CD002215

Gosden, T., Pedersen, L., & Torgerson, D. (1999). How should we pay doctors? A systematic review of salary payments and their effect on doctor behaviour. *QJM: An International Journal of Medicine*. 92(1):47-55. doi: 10.1093/qjmed/92.1.47. PMID: 10209672

Govule, P., Mugisha, J. F., Katongole, S. P., Maniple, E., Nanyingi, M., Anguyo, R., & Onzima, D. D. M. (2015). Application of Workload Indicators of Staffing Needs (WISN) in determining health workers' requirements for Mityana General Hospital, Uganda. *International Journal of Public Health Research*, 3(5), 254–263.

University of Ghana http://ugspace.ug.edu.gh

Graber, M. L. (2013). The incidence of diagnostic error in medicine. *BMJ Quality & Safety*, 22, ii21–ii27. https://doi.org/10.1136/bmjqs-2012-001615

Graber, M. L., Rusz, D., Jones, M. L., Farm-franks, D., Jones, B., Gluck, J. C., Thomas, D. B., Gleason, K. T., Welte, K., Abfalter, J., Dotseth, M., Westerhaus, K., Smathers, J., Adams, G., & Laposata, M. (2017a). The new diagnostic team. *Diagnosis*, 4(4), 225–238.

Graber, M. L., Siegal, D., Riah, H., Johnston, D., & Kenyon, K. (2019). Electronic health record-related events in medical malpractice claims. *Journal of Patient Safety, 15*(2), 77–85.

Gray, D. E. (2009). Theoretical perspectives and research methodologies. In *Doing research in the real world* (pp. 16–34).

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field Methods, 18*(1), 59–82. https://doi.org/10.1177/1525822X05279903

Ha, J. F., Hons, M., Anat, D. S., Longnecker, N., Charles, S., & Hospital, G. (2010). Doctor-Patient Communication: A Review. 38–43.

Habib, S. H., & Saha, S. (2010). Burden of non-communicable disease: global overview. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *4*(1), 41-47.

Hackmann, C., Wilson, J., Perkins, A., & Zeilig, H. (2019). Collaborative diagnosis between clinician and patient: why to do it and what to consider. *British Journal of Psychiatry, 25*, 214–222. https://doi.org/10.1192/bja.2019.6

University of Ghana http://ugspace.ug.edu.gh

Haddad, M., Sheybani, F., Naderi, H., Sasan, M. S., Najaf Najafi, M., Sedighi, M., & Seddigh, A. (2021). Errors in diagnosing infectious diseases: a physician survey. *Frontiers in Medicine*, *8*, 779454. https://doi.org/10.3389/fmed.2021.779454

Hajjaj, F. M., Salek, M. S., Basra, M. K. A., & Finlay, A. Y. (2010a). Non-clinical influences on clinical decision-making: a major challenge to evidence-based practice. *Journal of the Royal Society of Medicine, 103*(5), 178–187. https://doi.org/10.1258/jrsm.2010.100104

Hamilton-Fairley, D., Coakley, J., & Moss, F. (2014). Hospital at night: an organizational design that provides safer care at night. *BMC Medical Education*, *14*(1), 1-10.

Harel, Z., Silver, S. A., Mcquillan, R. F., Weizman, A. V, Thomas, A., Chertow, G. M., Nesrallah, G., Chan, C. T., & Bell, C. M. (2016). How to diagnose solutions to a quality-of-care problem. *Clinical Journal of the American Society of Nephrology, 11*(5), 901–907. https://doi.org/10.2215/CJN.11481015

Harrison, C., Fortin, M., Van Den Akker, M., Mair, F., Calderon-larranaga, A., Boland, F., Wallace, E., Jani, B., & Smith, S. (2021). Comorbidity versus multimorbidity: Why it matters. *Journal of Multimorbidity and Comorbidity, 11*, 1–3. https://doi.org/10.1177/2633556521993993

Harvey, L. A. (2018). REDCap: Web-based software for all types of data storage and collection editorial. *Spinal Cord, 56*(7), 625. https://doi.org/10.1038/s41393-018-0169-9

Hausmann, D., Kiesel, V., Zimmerli, L., Schlatter, N., von Gunten, A., Wattinger, N., & Rosemann, T. (2019). Sensitivity for multimorbidity: The role of diagnostic uncertainty of

University of Ghana http://ugspace.ug.edu.gh

physicians when evaluating multimorbid video case-based vignettes. *PLoS ONE, 14*(4), 1–16. https://doi.org/10.1371/journal.pone.0215049

Hausmann, D., Zulian, C., Battegay, E., & Zimmerli, L. (2016). Tracing the decision-making process of physicians with a Decision Process Matrix. *BMC Medical Informatics and Decision Making, 16*(33), 133. https://doi.org/10.1186/s12911-016-0369-1

Hautz, S. C., Schuler, L., Kämmer, J. E., Schauber, S. K., Ricklin, M. E., Sauter, T. C., Maier, V., Birrenbach, T., Exadaktylos, A., & Hautz, W. E. (2016). Factors predicting a change in diagnosis in patients hospitalised through the emergency room: A prospective observational study. *BMJ Open, 6*(5), 1–6. https://doi.org/10.1136/bmjopen-2016-011585

Hernández-Chana, S. G., Ceh-Varela, E. E., Sanchez-Cervantes, L. J., Villanueva-Escalante, M., Alejandro Rodríguez-González, & Pérez-Gallardo, Y. (2016). Collective intelligence in medical diagnosis systems: A case study. *Computers in Biology and Medicine, 74*, 45–53.

Hof, D. E., & Tarzian, A. J. (2001a). The girl who cried pain: A bias against women in the treatment of pain. *Journal of Law, Medicine & Ethics, 29*(1), 13–27.

Hofmann, S. G., & Hinton, D. E. (2014). Cross-cultural aspects of anxiety disorders. *Current Psychiatry Report, 16*(6), 450. https://doi.org/10.1007/s11920-014-0450-3

Hoshijima, H., Takeuchi, R., Mihara, T., Kuratani, N., Mizuta, K., Wajima, Z., Masaki, E., & Shiga, T. (2017). Weekend versus weekday admission and short-term mortality. *Medicine (United States), 96*(17), e6685. https://doi.org/10.1097/MD.0000000000006685

University of Ghana http://ugspace.ug.edu.gh

https://acces.bibl.ulaval.ca/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=2010682586&lang=fr&site=ehost-live

Hughes, V. (2015). Is there a relationship between night shift and errors? What nurse leaders need to know. *Athens Journal of Health, 3*(3), 217–228.

Hutchinson, A., Coster, J. E., Cooper, K. L., Mcintosh, A., Walters, S. J., Bath, P. A., Pearson, M., Rantell, K., Campbell, M. J., Nicholl, J., Irwin, P., & Street, R. (2010). Assessing quality of care from hospital case notes: comparison of reliability of two methods. *Quality and Safety in Health Care*, *19*(6), e2-e2. https://doi.org/10.1136/qshc.2007.023911

Institute for Health Metrics and Evaluation (IHME). (2014). *Health Service Provision in Uganda: Assessing facility capacity, costs of care, and patient perspectives*. Seattle, WA: IHME

Institute of Medicine. (1991). Medicare: New Directions in Quality Assurance Proceedings. The National Academies Press. https://doi.org/10.17226/1768

Institute of Medicine. (2001). Crossing the Quality Chasm: A New Health System for the 21st Century. The National Academies Press. https://doi.org/10.17226/10027

Ip, M. (2010). Keys to clear communication – how to improve comprehension among patients with limited health literacy. *Today's Dietitian, 12*(5), 4p.

Jawhari, B., Ludwick, D., Keenan, L., Zakus, D., & Hayward, R. (2016). Benefits and challenges of EMR implementations in low resource settings: a state-of-the-art review. *BMC Medical Informatics and Decision Making*, 16(116). https://doi.org/10.1186/s12911-016-0354-8

University of Ghana http://ugspace.ug.edu.gh

Jha, A., Bradford W. D., & David W. B. (2001). Fatigue, Sleepiness, and Medical Errors. In Shojania K.G; Duncan B.W, McDonald K.M., Wachter, R.M, Markowitz A.J (Ed.), *Making health care safer: a critical analysis of patient safety practices. Evidence Report/technology Assessment (Summary)* (1st ed., pp. 519–533). http://axotrack.com/ptsafety.pdf#page=529

Johnson, C. C., Fonner, V., Sands, A., Ford, N., Obermeyer, C. M., Tsui, S., Wong, V., & Baggaley, R. (2017). To err is human, to correct is public health: a systematic review examining poor quality testing and misdiagnosis of HIV status. *Journal of the International AIDS Society*, 20(Suppl 6), 21755. https://doi.org/10.7448/IAS.20.7.21755

Jones, K. (2011). The practice of quantitative methods. *Research methods in the social sciences*, 201-211. https://doi.org/10.1080/09S02380110107S62

Kabatooro, A., Ndoboli, F., & Namatovu, J. (2016). Patient satisfaction with medical consultations among adults attending Mulago hospital assessment centre. *Physiology & Behavior,* 58(3), 87–93. https://doi.org/10.1080/20786190.2016.1177977.Patient

Kadimba, E. G., Katongole, S. P., & Bikaitwoha, E. M. (2015). Medical Litigation in Hospitals in Kampala, Uganda. *International Journal of Public Health Research*, 3(5), 204–208.

Kaisey, M., Solomon, A. J., Luu, M., Giesser, B. S., & Sicotte, N. L. (2019). Incidence of multiple sclerosis misdiagnosis in referrals to two academic centers. *Multiple Sclerosis and Related Disorders,* 30, 51–56.

Kallioinen, N., Hill, A., Horswill, M. S., Ward, H. E., & Watson, M. O. (2015). Sources of inaccuracy in the measurement of adult patients' resting blood pressure in clinical settings:

University of Ghana http://ugspace.ug.edu.gh

A systematic review. *Journal of Hypertension*, 35(3), 421–441. https://doi.org/10.1097/HJH.0000000000001197

Kasten, M. J., Berman, A. C., Ebright, A. B., Mitchell, J. D., & Quirindongo-Cedeno, O. (2020). Interpreters in health care: A concise review for clinicians. *The American Journal of Medicine*, *133*(4), 424-428.

Katende, D., Mutungi, G., Baisley, K., Biraro, S., Ikoona, E., Peck, R., Smeeth, L., Hayes, R., Munderi, P., & Grosskurth, H. (2015). Readiness of Ugandan health services for the management of outpatients with chronic diseases. Tropical Medicine and International Health, 20(10), 1385–13

Katurura, M., & Cilliers, L. (2017). A review of the implementation of electronic health record systems on the African continent. In *Proceedings of African Computer and Information System & Technology Conference* (pp. 10-11).

Kedar, I., Ternullo, J. L., Weinrib, C. E., Kelleher, K. M., Brandling-Bennett, H., & Kvedar, J. C. (2003). Internet based consultations to transfer knowledge for patients requiring specialised care: retrospective case review. *BMJ*, *326*(7391), 696-699.

Khullar, D., Jha, A. K., & Jena, A. B. (2016). Reducing diagnostic errors- why now? *N Engl J Med*, 373(26), 2491–2493. https://doi.org/10.1056/NEJMp1508044

Kiboga District. (2020b). *Kiboga District Local Government Second Development District Plan* 2020/21-2024/25. Kiboga, Kiboga District

University of Ghana http://ugspace.ug.edu.gh

Kijima, T., Akai, K., Nabika, T., Taniguchi, E., Matsushita, A., & Ishibashi, Y. (2018a). Diagnostic difficulties and factors affecting diagnosis in acutely ill elderly Japanese patients living at home. *International Journal of Gerontology*, 12(4), 326–330. https://doi.org/10.1016/j.ijge.2018.05.004

Kimberlin, C. L., & Winterstein, A. G. (2008). Validity and reliability of measurement instruments used in research. *American Journal of Health-System Pharmacy*, 65(23), 2276–2284. https://doi.org/10.2146/ajhp070364

King, P, Wanyana M. W., Mayinja, H., Nakafeero-Simbwa, B, Zalwango1 M. G., Kobusinge, J. O., Migisha, R., Kadobera, D., Kwesiga, B., Bulage, L., Gonahasa, D., Babigumira, P. A., Nchoko, S., Salat, E., Waithaka, F., Gunya, O., Odhiambo, F., Mutabazi, V., Habimana, M., Twagirimana, G., Ndabarinze, E., Manishimwe, A., Itiakorit, H., KadivaniI, S., Seib, K., Whitney, E., Riolexus, A. A. (2024) Cross border population movements across three East African states: Implications for disease surveillance and response. *PLOS Glob Public Health* 4(10): e0002983. https://doi.org/10.1371/journal.pgph.0002983

Kirch, W., & Scafii, C. (1994). Reflections on misdiagnosis. *Journal of Internal Medicine*, 235(5), 399–404.

Kirch, W., Shapiro, F., & Fölsch, U. R. (2004). Health care quality: Misdiagnosis at a university hospital in five medical eras. Autopsy-confirmed evaluation of 500 cases between 1959 and 1999/2000: A follow-up study. *Journal of Public Health*, 12(3), 154–161. https://doi.org/10.1007/s10389-004-0038-1

University of Ghana http://ugspace.ug.edu.gh

Kivunja, A. C., Ahmed, A., & Kuyini, B. (2017). Understanding and applying research paradigms in educational contexts. *International Journal of Higher Education*, 6(5), 26–41. https://doi.org/10.5430/ijhe.v6n5p26

Klein, J. P., & Moeschberger, M. L. (1997). Statistics for biology and health. *New York*, *27238*, Springer.

Kohl, S. (2018). OECD — delivering quality health services: a global imperative. *European Journal of Hospital Pharmacy*, 25(5), 286–288.

Kohler, U., & Frauke, K. (2012). Data Analysis Using Stata. Stata Press

Kostopoulou, O., Delaney, B. C., & Munro, C. W. (2008). Diagnostic difficulty and error in primary care — a systematic review. September. https://doi.org/10.1093/fampra/cmn071

Kotovicz, F., Mauad, T., & Saldiva, P. H. N. (2008). Clinico-pathological discrepancies in a general university hospital in São Paulo. *Clinical Science*, 63(5), 581–588. https://doi.org/10.1590/S1807-59322008000500003

Kovacs, R. J., Lagarde, M., & Cairns, J. (2020). Overconfident health workers provide lower quality healthcare. *Journal of Economic Psychology, 76*, 102213. https://doi.org/10.1016/j.joep.2019.102213

Kruk, M. E., Gage, A. D., Joseph, N. T., Danaei, G., García-saisó, S., Salomon, J. A., Bill, F., & Foundation, M. G. (2018). Mortality due to low-quality health systems in the universal health coverage era: a systematic analysis of amenable deaths in 137 countries. *The Lancet, 392*, 2203–2212. https://doi.org/10.1016/S0140-6736(18)31668-4

University of Ghana http://ugspace.ug.edu.gh

Kuijpers, C. C. H. J., Fronczek, J., Van De Goot, F. R. W., Niessen, H. W. M., Van Diest, P. J., & Jiwa, M. (2014). The value of autopsies in the era of high-tech medicine: discrepant findings persist. *Journal of Clinical Pathology, 67*, 512–519. https://doi.org/10.1136/jclinpath-2013-202122

Kurvers, R. H. J. M., Herzog, S. M., Hertwig, R., Krause, J., Carney, P. A., Bogart, A., Argenziano, G., Zalaudek, I., & Wolf, M. (2016). Boosting medical diagnostics by pooling independent judgments. *Proceedings of the National Academy of Sciences of the United States of America, 113*(31), 8777–8782. https://doi.org/10.1073/pnas.1601827113

Kwesiga, B., Aliti, T., Nabukhonzo, P., Najuko, S., Byawaka, P., Hsu, J., Ataguba, J. E., & Kabaniha, G. (2020). What has been the progress in addressing financial risk in Uganda? Analysis of catastrophe and impoverishment due to health payments. *BMC Health Services Research, 20*(741). https://doi.org/10.1186/s12913-020-05500-2

Lagay, F. (2000). Intentional Misdiagnosis to Get Insurance Coverage. *AMA Journal of Ethics*, *2*(4), 28. https://doi.org/10.1001/virtualmentor.2000.2.4.hlaw1-0004

Lam, K. W., Hassan, A., Sulaiman, T., & Kamarudin, N. (2018). Evaluating the Face and Content Validity of an Instructional Technology Competency Instrument for University Lecturers in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 8(5), 363–381. https://doi.org/10.6007/IJARBSS/v8-i5/4108

Laposata, M. (2014). Errors in clinical laboratory test selection and result interpretation: commonly unrecognized mistakes as a cause of poor patient outcome. *Diagnosis, 1*(1), 85–87. https://doi.org/10.1515/dx-2013-0010

University of Ghana http://ugspace.ug.edu.gh

Laposata, M. (2018). The Definition and scope of diagnostic error in the US and how diagnostic error is enabled. *Journal of Applied Laboratory Medicine, 3*(1), 128–134. https://doi.org/10.1373/jalm.2017.025882

Lazzari, C., Shoka, A., & Mousailidis, G. (2018). Sleep deprivation in health workers and medical errors: how to recognize them? *Sleep Medicine and Disorders: International Journal, 2*(1), 15–16. https://doi.org/10.15406/smdij.2018.02.00034

Lee, M. (Ed.). (2017). *Basic skills in interpreting laboratory data* (6th ed.). Bethesda, Maryland, American Society of Health-System Pharmacists, Inc.

Leske, M. C., Sorensen, A. A., & Zimmer, J. G. (2018). Discrepancies between Admission and Discharge Diagnoses in a University Hospital. *Medicare, 16*(9), 740–748. https://www.jstor.org/stable/3763504

Leslie, H. H., Ndiaye, Y., & Kruk, M. E. (2017). Effective coverage of primary care services in eight high-mortality countries. *BMJ Global Health*, *2*(3), e000424. https://doi.org/10.1136/bmjgh-2017-000424

Levinson, W., Kao, A., Kuby, A., & Thisted, R. A. (2005). Not all patients want to participate in decision making. *Journal of General Internal Medicine, 20*(6), 531–535. https://doi.org/10.1111/j.1525-1497.2005.04101.x

Lighthall, G. K., & Vazquez-Guillamet, C. (2015). Understanding decision making in critical care. *Clinical Medicine and Research, 13*(3–4), 156–168. https://doi.org/10.3121/cmr.2015.1289

University of Ghana http://ugspace.ug.edu.gh

Liu, D., Gan, R., Zhang, W., Wang, W., Saiyin, H., Zeng, W., & Liu, G. (2018). Autopsy interrogation of emergency medicine dispute cases: how often are clinical diagnoses incorrect? *Journal of Clinical Pathology*, *71*(1), 67-71. https://doi.org/10.1136/jclinpath-2017-204484

Louis, M. A., Doubleday, A. R., Lin, E., Baek, J. Y., Andoni, A., & Wang, X. H. (2016). Case Report Abdominal Pain in the Female Patient: A Case of Concurrent Acute Appendicitis and Ruptured Endometrioma. *Case Reports in Surgery*, 2016 (1), 1–4.

Luna, F., & Luyckx, V. A. (2020). Why have non-communicable diseases been left behind? *Asian Bioethics Review*, *12*, 5-25.

Mack, C., Su, Z., & Westreich, D. (2018). Managing Missing Data in Patient Registries: Addendum to Registries for Evaluating Patient Outcomes: A User's Guide, Third Edition. Rockville, MD: *Agency for Healthcare Research and Quality*., 7–8. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK493614/

Mahumud, R. A., Sultana, M., Sheikh, N., Ali, M. N., Mitra, D. K., & R, S. A. (2016a). Diagnostic errors in low and middle-income countries: Future health and economic burden for patient safety. *Austin Emergency Medicine*, 2(8), 8–10.

Male, L., Noble, A., Atkinson, J., & Marson, T. (2017). Measuring patient experience: a systematic review to evaluate psychometric properties of patient reported experience measures (PREMs) for emergency care service provision. *International Journal for Quality in Health Care*, 29(3), 314–326. https://doi.org/10.1093/intqhc/mzx027

University of Ghana http://ugspace.ug.edu.gh

Mamede, S., Schmidt, H. G., & Rikers, R. (2007). Diagnostic errors and reflective practice in medicine. *Journal of Evaluation in Clinical Practice*, 13(1), 138–145. https://doi.org/10.1111/j.1365-2753.2006.00638.x

Marois, A., & Lafond, D. (2022). Augmenting cognitive work: a review of cognitive enhancement methods and applications for operational domains. *Cognition, Technology & Work*, *24*(4), 589-608.

Marquez, P. V, & Farrington, J. L. (2013). The challenge of non-communicable diseases and road traffic injuries in Sub-Saharan Africa. An Overview. Washington, DC: The world bank (CC BY-NC-ND 3.0 IGO).

Marrie, R. A., Horwitz, R., Cutter, G., Tyry, T., Campagnolo, D., & Vollmer, T. (2009). Comorbidity delays diagnosis and increases disability at diagnosis in MS. *Neurology*, 72, 117–124.

Marutha, N. S., & Ngoepe, M. (2017). The role of medical records in the provision of public healthcare services in the Limpopo province of South Africa Research problem. *South African Journal of Information Management*, 19(1), 1–8.

Masamba, L. P. L., Jere, Y., Brown, E. R. S., & Gorman, D. R. (2016). Tuberculosis diagnosis delaying treatment of cancer: experience from a new oncology unit in Blantyre, Malawi. *Journal of Global Oncology*, 2(1), 26–29. https://doi.org/10.1200/jgo.2015.000299

Mathew, A., Fyyaz, S. A., Carter, P. R., & Potluri, R. (2018). The enigma of the weekend effect. *Journal of Thoracic Disease*, 10(1), 102–105. https://doi.org/10.21037/jtd.2017.12.115

University of Ghana http://ugspace.ug.edu.gh

Mbonye, M. K., Burnett, S. M., Colebunders, R., Naikoba, S., Van Geertruyden, J., Weaver, M. R., & Ronald, A. (2014). Disease diagnosis in primary care in Uganda. *BMC Family Practice*, 15(1). https://doi.org/http://www.biomedcentral.com/1471-2296/15/165

McDonald, K. M., Bryce, C. L., & Graber, M. L. (2013). The patient is in: patient involvement strategies for diagnostic error mitigation. *BMJ Quality & Safety*, 2, 22, ii33-39. https://doi.org/10.1136/bmjqs-2012-001623

McGregor, A. J. (2019). Are Women More Likely to Exhibit Psychogenesis…Or Just More Likely to Be Diagnosed That Way? *Rhode Island Medical Journal*, 102(3), 10–11.

McHugh, M. L. (2012). Lessons in biostatistics Interrater reliability: the kappa statistic. *Biochemia Medica*, 22(2), 276–282.

McNair, R., Taft, A., & Hegarty, K. (2008). BMC Medical Research Methodology. *BMC Medical Research Methodology*, 6(73). https://doi.org/10.1186/1471-2288-8-73

McNutt, R., Johnson, T., & Kane, J. (2012). Cost and Quality Implications of Discrepancies Between Admitting and Discharge Diagnoses. *Quality Management in Health Care* 21(4). 220-227. https://doi.org/10.1097/QMH.0b013e31826d1ed2

McPherson, K. M., Harwood, M., & McNaughton, H. K. (2017). *BMJ Quality & Safety*, 12(4), 237–241.

Meghani, S. H., Buck, H. G., Dickson, V. V., Hammer, M. J., Rabelo-Silva, E. R., Clark, R., & Naylor, M. D. (2013). The Conceptualization and Measurement of Comorbidity: A Review

University of Ghana http://ugspace.ug.edu.gh

of the Interprofessional Discourse. *Nursing Research and Practice*, 2013(1), 1-10. https://doi.org/10.1155/2013/192782

Mehta, N., & Pandit, A. (2018). Concurrence of big data analytics and healthcare: A systematic review. *International Journal of Medical Informatics*, 114 (1), 57–65. https://doi.org/10.1016/j.ijmedinf.2018.03.013

Meissner, H., Creswell, J., Klassen, A. C., Plano, V., & Smith, K. C. (2011). Best Practices for Mixed Methods Research in the Health Sciences. Methods, 29, 1–39. https://doi.org/10.1002/cdq.12009

Meyer, D., & Naglak, M. C. (2020). Create a safe night: An interdisciplinary approach to risk identification and mitigation for hospitalized. *Patient Safety*, 4(1), 57–63. https://doi.org/10.33940/culture/2020.3.5

Michel, P. (2003). Strengths and weaknesses of available methods for assessing the nature and scale of harm caused by the health system: Literature review. Geneva, Switzerland: World Health Organization.

Micklesfield, L. K., Munthali, R., Agongo, G., Asiki, G., Boua, P., Choma, S. S., ... & Ramsay, M. (2023). Identifying the prevalence and correlates of multimorbidity in middle-aged men and women: a cross-sectional population-based study in four African countries. *BMJ Open*, *13*(3), e067788.

Mingers, J. (2003). A critique of statistical modelling from a critical realist perspective. In Proceedings of the 11th European Conference on Information Systems, ECIS 2003, Naples, Italy, 16–21; pp. 1277–1288.

University of Ghana http://ugspace.ug.edu.gh

Ministry of Finance Planning and Economic Development. (2016). Private wings in government hospitals: What are the challenges? BMAU Briefing Paper (13/16); Issue 2016).

Ministry of Finance, Planning and Economic Development (2018). *State of Uganda Population Report* 2018. UBOS, Kampala

Ministry of Health, Health Systems 20/20 (2012). Uganda Health System Assessment 2011. Kampala, Ministry of Health

Ministry of Health. (2010). Health Management Information System Manual (1st ed., Vol. 1, pp. 1–394). Kampala: Ministry of Health.

Ministry of Health. (2013). *Guidelines for governance and management structure*. Ministry of Health, Kampala.

Ministry of Health. (2014). *Uganda Hospital and Health Centre IV Census Survey* 2014. Ministry of Health, Kampala.

Ministry of Health. (2015). *Health Financing Strategy 2015/16 – 2024/25*. Kampala: Ministry of Health.

Ministry of Health. (2017a). *Annual Health Sector Performance Report* 2017/2018. Kampala: Ministry of Health.

Ministry of Health. (2017b). *Human Resources for Health Audit* 2017/2018. Kampala: Ministry of Health.

Ministry of Health. (2019). *Annual Health Sector Performance Report* 2018/19. Kampala: Ministry of Health.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

Ministry of Health. (2020). *Annual Health Sector Performance Report* 2019/2020. Kampala: Ministry of Health.

Ministry of Health. (2021). *Annual Health Sector Performance Report* 2020/2021. Kampala: Ministry of Health.

Ministry of Health, Planning, Finance and Policy Department (2023). *Annual Health Sector Performance Report*. Ministry of Health. Kampala. http://health.go.ug/

Ministry of Public Service. (2011). Job descriptions and specifications for jobs in local government. Ministry of Public Service, Kampala.

Mishra, B., Sinha, N. D., Gidwani, H., & Shukla, S. K. (2013). Equipment Errors: A Prevalent Cause for Fallacy in Blood Pressure Recording - A Point Prevalence Estimate from an Indian Health University. *Indian Journal of Community Medicine*, 38(1), 1–21. https://doi.org/10.4103/0970-0218.106622

Mogyorosy, Z., & Smith, P. (2005). The main methodological issues in costing health care services: a literature review. *Centre for Health Economics, University of York Working Papers*, (007cherp).

Mohamed, F., Mamede, S., Mohamedani, M., & Al, I. (2016). The effect of patients' appearance on doctors' diagnostic decision making: Do poor people get poorer medical care? *Health Professions Education*, 2(1), 18–23. https://doi.org/10.1016/j.hpe.2016.01.011

Mounce, L. T. A., Price, S., Valderas, J. M., & Hamilton, W. (2017). Comorbid conditions delay diagnosis of colorectal cancer: a cohort study using electronic primary care records. *British Journal of Cancer*, 116(12), 1536–1543. https://doi.org/10.1038/bjc.2017.127

University of Ghana http://ugspace.ug.edu.gh

Mugisha, M., (2018, October, 5). Reviving functionality of referral system in Uganda. *Monitor*. Retrieved from https://www.monitor.co.ug/uganda/oped/commentary/reviving-functionality-of-referral-system-in-uganda-1782352.

Mukasa, N. (2012). Uganda Healthcare system profile: Background, organization, polices and challenges. *Journal of Sustainable Regional Health Systems*, 1(1), 2–10.

Murrow, E. J., & Oglesby, F. M. (1996). Acute and chronic illness: similarities, differences and challenges. *Orthopaedic Nursing*, 15(5), 47–51.

Nalugwa, T., Shete, P. B., Nantale, M., Farr, K., Ojok, C., Ochom, E., Mugabe, F., Joloba, M., Dowdy, D. W., Moore, D. A. J., Davis, J. L., Cattamanchi, A., & Katamba, A. (2020). Challenges with scale-up of GeneXpert MTB/RIF® in Uganda: A health systems perspective. *BMC Health Services Research,* 20(162). https://doi.org/10.1186/s12913-020-4997-x

NAM. (2015). Improving diagnosis in health care. In E. P. Balogh, B. T. Miller, & J. R. Ball (Eds.), *Improving Diagnosis in Health Care* (National A). The National Academies Press. https://doi.org/10.17226/21794

Namaganda, G., Oketcho, V., Maniple, E., & Viadro, C. (2015). Making the transition to workload-based staffing: using the Workload Indicators of Staffing Need method in Uganda. *Human Resources for Health,* 13(89), 1–11. https://doi.org/10.1186/s12960-015-0066-7

Nandini, T. (2016). An Analysis of Iceberg of Errors in Clinical Laboratory. *International Journal of Healthcare and Biomedical Research*, 4(3), 108–112.

University of Ghana http://ugspace.ug.edu.gh

Nankabirwa, J., Zurovac, D., Njogu, J. N., Rwakimari, J. B., Counihan, H., Snow, R. W., & Tibenderana, J. K. (2009). Malaria misdiagnosis in Uganda implications for policy change. *Malaria Journal*, 8(1), 1–9. https://doi.org/10.1186/1475-2875-8-66

Nargesi, A. A., Ghazizadeh, Z., Larry, M., Morteza, A., Heidari, F., Asgarani, F., Esteghamati, A., Mohammad, K., & Nakhjavani, M. (2014). Manual or automated sphygmomanometer? A historical cohort to quantify measurement bias in blood pressure recording. *Journal of Clinical Hypertension*, *16*(10), 716–721. https://doi.org/10.1111/jch.12400

National Population Council. (2021b). *Population Growth in Uganda: Challenges and Opportunities*. Kampala, UBOS

Navickas, R., Petric, V.-K., Feigl, A. B., & Seychell, M. (2016a). Multimorbidity: What Do We Know? What Should We Do? *Journal of Comorbidity*, 6(1), 4–11. https://doi.org/10.15256/joc.2016.6.72

Neale, G., Hogan, H., Sevdalis, N., Neale, G., Hogan, H., & Sevdalis, N. (2011). Misdiagnosis: analysis based on case record review with proposals aimed to improve diagnostic processes. *Clinical Medicine*, 11(4), 317–321.

Negasi, K. B., Tefera Gonete, A., Getachew, M., Assimamaw, N. T., & Terefe, B. (2022). Length of stay in the emergency department and its associated factors among pediatric patients attending Wolaita Sodo University Teaching and Referral Hospital, Southern, Ethiopia. *BMC Emergency Medicine*, *22*(1), 3–11. https://doi.org/10.1186/s12873-022-00740-3

University of Ghana http://ugspace.ug.edu.gh

Neshati, H., Sheybani, F., Naderi, H., Sarvghad, M., Soltani, A. K., Efterkharpoor, E., & Nooghabi, M. J. (2018). Diagnostic errors in Tuberculous patients: A multicenter study from a developing country. *Journal of Environmental and Public Health*, 2018. https://doi.org/10.1155/2018/1975931

Newman-Toker, D. E. (2014). A unified conceptual model for diagnostic errors: underdiagnosis , overdiagnosis , and misdiagnosis. Diagnosis, 1(1), 43–48. https://doi.org/10.1515/dx-2013-0027

Newman-Toker, D. E., Austin, J. M., Derk, J., Danforth, M., & Graber, M. L. (2017). Are health care provider organizations ready to tackle diagnostic error? A survey of Leapfrog-participating hospitals. *Journal of Patient Safety*, 13(4), 205–212. https://doi.org/10.1097/PTS.0000000000000408

Newman-Toker, D.E., Nassery, N., Schaffer, A.C., Yu-Moe, C.W., Clemens, G.D., Wang, Z., Zhu, Y., Tehrani, A.S.S., Fanai, M., Hassoon, A. and Siegal, D., 2023. Burden of serious harms from diagnostic error in the USA. *BMJ Quality & Safety*. doi: 10.1136/bmjqs-2021-014130

Nguyen, V. T. T., Best, S., Pham, H. T., Xuan, T., Troung, L., Thanh, T., & Hoang, H. (2017). HIV point of care diagnosis: preventing misdiagnosis experience from a pilot of rapid test algorithm implementation in selected communes in Vietnam. *Journal of the International AIDS Society*, 20(7), 67–74. https://doi.org/10.7448/IAS.20.7.21752

Nour, S., & Plourde, G. (2019). Pharmacoepidemiology in the Prevention of Adverse Drug Reactions. In *Pharmacoepidemiology and pharmacovigilance* (pp. 25–56). https://doi.org/10.1016/B978-0-12-816183-8.00003-2

University of Ghana http://ugspace.ug.edu.gh

O'Daniel, M., & Rosenstein, A. H. (2008a). Professional communication and collaboration. In R. G. Hughes (Ed.), *Patient Safety and Quality: An Evidence-Based Handbook for Nurses* (Second Edi, pp. 51–66). Agency for Healthcare Research and Quality. https://doi.org/10.4135/9781483329512.n4

Odekunle, F. F., Odekunle, R. O., & Srinivasan, S. (2017). Why Sub-Saharan Africa lags in electronic health record (EHR) adoption and possible strategies to increase EHR adoption in this region. *International Journal of Health Sciences & Research*, 7(1), 282–290.

of resources: a program to introduce the basics. *Canadian Family Physician*, *60*(3), e167-e172.

Ojurongbe, O., Adegbosin, O. O., Taiwo, S. S., Alli, O. A. T., Olowe, O. A., Ojurongbe, T. A., Bolaji, O. S., & Adeyeba, O. A. (2013). Assessment of Clinical Diagnosis, Microscopy, Rapid Diagnostic Tests, and Polymerase Chain Reaction in the Diagnosis of Plasmodium falciparum in Nigeria. *Malaria Research and Treatment*, 2013, 1–5. https://doi.org/10.1155/2013/308069

Ordi, J., Ismail, M. R., Carrilho, C., Romagosa, C., Osman, N., Machungo, F., Bombí, J. A., Balasch, J., Alonso, P. L., & Menéndez, C. (2009). Clinico-pathological discrepancies in the diagnosis of causes of maternal death in sub-Saharan Africa: Retrospective analysis. *PLoS Medicine,* 6(2), 0174–0180. https://doi.org/10.1371/journal.pmed.1000036

Orton, P. K., & Pereira Gray, D. (2016). Factors influencing consultation length in general/family practice. *Family Practice*, 33(5), 529–534. https://doi.org/10.1093/fampra/cmw056

University of Ghana http://ugspace.ug.edu.gh

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research. *Administration and Policy in Mental Health and Mental Health Services Research*, 42(5), 533–544. https://doi.org/10.1007/s10488-013-0528-y

Panagioti, M., Stokes, J., Esmail, A., Coventry, P., Cheraghi-Sohi, S., Alam, R., & Bower, P. (2015). Multimorbidity and patient safety incidents in primary care: A systematic review and meta-analysis. *PLoS ONE*, 10(8), 1–30. https://doi.org/10.1371/journal.pone.0135947

Park, H. A. (2013). An introduction to logistic regression: from basic concepts to interpretation with particular attention to nursing domain. *Journal of Korean Academy of Nursing*, *43*(2), 154-164.

Peduzzi, P., Concato, J., Kemper, E., Holford, T. R., & Feinstein, A. R. (1996). A simulation study of the number of events per variable in logistic regression analysis. *Journal of Clinical Epidemiology*, 49(12), 1373–1379.

Peersman, G. (2014). Overview: Data Collection and Analysis Methods in Impact Evaluation: Methodological Briefs-Impact Evaluation No. 10. *Methodological Briefs Papers*, (innpub755).

Peng, A., Rohacek, M., Ackermann, S., Ilsemann-Kakaroumis, J., Ghanim, L., Messmer, A., ... & Bingisser, R. (2015). The proportion of correct diagnoses is low in emergency patients with nonspecific complaints presenting to the emergency department. *Swiss Medical Weekly*, *145*(0910), w14121-w14121.

University of Ghana http://ugspace.ug.edu.gh

Petti, C. A., Polage, C. R., Quinn, T. C., Ronald, A. R., & Sande, M. A. (2006). Laboratory Medicine in Africa: A Barrier to Effective Health Care. *Clinical Infectious Diseases*, 42(3), 377–382. https://doi.org/10.1086/499363

Picarillo, A. P. (2018). Introduction to quality improvement tools for the clinician. *Journal of Perinatology*, 38, 929–935. https://doi.org/10.1038/s41372-018-0100-4

Pieretti, S., Giannuario, A. Di, Giovannandrea, R. Di, Marzoli, F., Piccaro, G., Minosi, P., & Aloisi, A. M. (2016). Gender differences in pain and its relief. 52(2), 184–189. https://doi.org/10.4415/ANN

Plant, M. (2001). Critical realism: a common-sense philosophy for environmental education? The 26th ATEE (Association for Teacher Education in Europe) Conference, 1–7.

Plant, M. (2001,). Critical realism: A common sense philosophy for environmental education? Paper presented at the 26th Association for Teacher Education in Europe Conference, August–September, Stockholm.

Plebani, M. (2006). Errors in clinical laboratories or errors in laboratory medicine? *Clinical Chemistry Laboratory Medicine*, 44(6), 750–759. https://doi.org/10.1515/CCLM.2006.123

Pontis, S., Blandford, A., Greifeneder, E., Attalla, H., & Neal, D. (2017). Keeping up to date: An academic researcher's information journey. *Journal of the Association for Information Science and Technology*, *68*(1), 22-35.

Pratschke, J. (2003) Realistic models? Critical realism and statistical models in the social sciences. *Philosphica* 71: 13–38

University of Ghana http://ugspace.ug.edu.gh

Quinn, A. E., Trachtenberg, A. J., Mcbrien, K. A., Ogundeji, Y., Souri, S., Manns, L., Rennert-may, E., Ronksley, P., Au, F., Arora, N., Hemmelgarn, B., Tonelli, M., & Manns, B. J. (2020a). Impact of payment model on the behaviour of specialist physicians: A systematic review. *Health Policy*, 124(4), 345–358. https://doi.org/10.1016/j.healthpol.2020.02.007

Rabie, T. S., Towfighian, S. N., Clark, C., & Cammett, M. (2017). *The Last Mile to Quality Service Delivery in Jordan*. World Bank. https://doi.org/10.1596/978-1-4648-1069-5

Rademakers, J., Delnoij, D., Nijman, J., & De Boer, D. (2012b). Educational inequalities in patient-centred care: Patients' preferences and experiences. *BMC Health Services Research*, 12(1). https://doi.org/10.1186/1472-6963-12-261

Ranjit, K. (2019). *Research methodology: A step-by-step guide for beginners* (5th ed.). London, SAGE Publications Ltd.

Regitz-zagrosek, V. (2012). Sex and gender differences in health. *EMBO Reports*, 13(7), 596–603. https://doi.org/10.1038/embor.2012.87

Reis, M. D., Kosmach, S., & Khan, M. M. (2013). Electronic health record-based surveillance of diagnostic errors in primary care. *BMJ Quality & Safety*, 21(2), 93–100. https://doi.org/10.1136/bmjqs-2011-000304.Electronic

Rendon, P., Roesch, J., Rao, D., & Rencic, J. (2015). Tips for hospitalists on improving Diagnostic Skills. *The Hospitalist*, 10(11), 1.

Rhoades, D. R., Mcfarland, K. F., Finch, W. H., & Johnson, A. O. (2001). Speaking and interruptions during primary care office visits. *Family Medicine*, 33(7), 528–532.

University of Ghana http://ugspace.ug.edu.gh

Richards, H. M., & Schwartz, L. J. (2002). Ethics of qualitative research: are there special issues for health services research? *Family Practice*, 19(2), 135–139. https://doi.org/10.1093/fampra/19.2.135

Rock, B., Place, H., Cummins, D. S., Vangeest, J. B., & Wilson, I. B. (2000). Physician manipulation of reimbursement rules for patients. Journal of American Medical Association, 283(14), 1858–1865.

Romano, P., Hussey, P., & Ritley, D. (2010). *Selecting quality and resource use measures: A decision guide for community quality collaboratives* (pp. 1-106). Rockville, MD, USA: US Department of Health and Human Services, Agency for Healthcare Research and Quality.

Rutebemberwa, E., Katureebe, S. K., Mwaka, A. D., Atuyambe, L., & Gitta, S. N. (2013). Perceptions of diabetes in rural areas of Eastern Uganda. *Curationis*, *36*(1), 1-7. https://doi.org/10.4102/curationis.v36i1.121

Ryan, G. S. (2019). Post-positivist, critical realism: philosophy, methodology and method for nursing research. *Nurse Researcher*, 27(3), 20–26.

Salazar, L. F., Crosby, R. A., & DiClemente, R. J. (2006). *Research Methods in Health Promotion* (2nd ed). San Francisco, Jossey Bass.

Sanders, M. N., Lewis, P., Adrian, T., & Bristow, A. (2015). Understanding research philosophies and approaches to theory development. In M. N. Sanders, P. Lewis, T. Adrian, & A. Bristow (Eds.), *Research methods for business students* (pp. 122–161). University of Birmingham, Pearson Education.

University of Ghana http://ugspace.ug.edu.gh

Sandikci, K. B., Üstü, Y., & Sandikci, M. M. (2017). Attitudes and behaviors of physicians in dealing with difficult patients. *Turkish Journal of Family Medicine and Primary Care*, 11(3), 176–183. https://doi.org/10.21763/tjfmpc.328156

Saunders, M., Lewis, P., & Thornhill, A. (2019). Understanding research philosophy and approaches to theory development. In *Research Methods for Business Students* (8th ed., pp. 128-169). Pearson Publishers.

Sblano, S., Arpaio, A., Zotti, F., Marzullo, A., Interdisciplinare, D., Legale, M., Aldo, B., & Aldo, B. (2014). Discrepancies between clinical and autoptic diagnoses in Italy: evaluation of 879 consecutive cases at the "Policlinico of Bari" teaching hospital in the period 1990-2009. *Clinical and Autoptic Diagnoses*, 50(1), 44–48. https://doi.org/10.4415/ANN

Schiff, G. D. (2009). Diagnostic Error in Medicine. *Archives of Internal Medicine*, 169(20), 1881. https://doi.org/10.1001/archinternmed.2009.333

Schiff, G. D., Hasan, O., Kim, S., Abrams, R., Cosby, K., Lambert, B. L., ... & McNutt, R. A. (2009). Diagnostic error in medicine: analysis of 583 physician-reported errors. *Archives of Internal Medicine*, *169*(20), 1881-1887.

Schiff, G. D., Kim, S., Abrams, R., Cosby, K., Lambert, B., & Elstein, A. S. (2005). Diagnosing diagnosis errors: lessons from a multi-institutional collaborative project. In K. Henriksen, J. B. Battles, E. S. Marks, & D. I. Lewin (Eds.), Advances in Patient Safety: From Research to Implementation: Volume 2: Concepts and Methodology (pp. 255-278). Agency for Healthcare Research and Quality.

University of Ghana http://ugspace.ug.edu.gh

Schottenfeld, L., Petersen, D., Peikes, D., Ricciardi, R., Burak, H., McNellis, R., & Genevro, J. (2016). Creating Patient-Centered Team-Based Primary Care. Agency for Healthcare Research and Quality. Rockville, MD. (AHRQ Pub. No. 16-0002-EF).

Scot, D. (2014). Ontology, epistemology, strategy and method in educational research. A critical realist approaches. Magis, Revista Internacional de Investigación En Educación, 7(14), 29–38. https://doi.org/10.11144/Javeriana.M7-14.OESM

Scotland, J. (2012). Exploring the philosophical underpinnings of research: Relating ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms. English Language Teaching, 5(9), 9–16. https://doi.org/10.5539/elt.v5n9p9

Sears, D., Mpimbaza, A., Kigozi, R., Sserwanga, A., Chang, M. A., Kapella, B. K., Yoon, S., Kamya, M. R., Dorsey, G., & Ruel, T. (2015). Quality of inpatient pediatric case management for four leading causes of Child Mortality at Six Government-Run Ugandan Hospitals. *PLoS Medicine*, 10(5), e0127192. https://doi.org/10.1371/journal.pone.0127192

Shannon-Baker, P. (2016). Making Paradigms Meaningful in Mixed Methods Research. *Journal of Mixed Methods Research*, 10(4), 319–334. https://doi.org/10.1177/1558689815575861

Sharma, S. K., & Rani, R. (2020). Nurse to patient ratio and nurse staffing norms for hospitals in India: A critical analysis of national benchmarks. *Journal of Family Medicine and Primary Care*, 9(2), 2631–2637. https://doi.org/10.4103/jfmpc.jfmpc

Shenvi, E. C., & El-kareh, R. (2015). Clinical criteria to screen for inpatient diagnostic errors: a scoping review. *Diagnosis,* 2(1), 3–19. https://doi.org/10.1515/dx-2014-0047

University of Ghana http://ugspace.ug.edu.gh

Shiino, Y., Hifumi, T., Otomo, Y., Okamoto, K., Kotani, J., Sakamoto, Y., Sasaki, J., Shiraishi, Takuma, K., Hagiwara, A., Yamakawa, K., Takeyama, N., & Gando, S. (2019). In-hospital mortality associated with the misdiagnosis or unidentified site of infection at admission. *Critical Care,* 23, 1-9. https://doi.org/10.1186/s13054-019-2475-9

Singh, H. (2015). Measurement of diagnostic errors is a key first step to their reduction. PSNet. Retrieved from https://www.researchgate.net/publication/325860531_Measurement_of_Diagnostic_Errors_Is_a_Key_First_Step_to_Their_Reduction

Singh, H., Giardina, T. D., Forjuoh, S. N., Reis, M. D., Kosmach, S., Khan, M. M., & Thomas, E. J. (2012). Electronic health record-based surveillance of diagnostic errors in primary care. *BMJ Quality & Safety*, *21*(2), 93-100.

Singh, H., Giardina, T. D., Meyer, A. N. D., Forjuoh, S. N., Reis, M. D., & Thomas, E. J. (2013). Types and origins of diagnostic errors in primary care settings. *JAMA Internal Medicine*, 173(6), 418–425. https://doi.org/10.1001/jamainternmed.2013.2777

Singh, H., Graber, M. L., & Timothy, P. (2019). Measures to Improve Diagnostic Safety in Clinical Practice. *Journal of Patient Safety*, *15*(4), 311–316.

Singh, H., Meyer, A. N. D., & Thomas, E. J. (2014). The frequency of diagnostic errors in outpatient care: estimations from three large observational studies involving US adult populations. *BMJ Quality & Safety*, *23*(9), 727–731. https://doi.org/10.1136/bmjqs-2013-002627

Singh, H., Schiff, G. D., Graber, M. L., Onakpoya, I., & Thompson, M. J. (2017). The global burden of diagnostic errors in primary care. *BMJ Quality & Safety*, *26*(6), 484–494. https://doi.org/10.1136/bmjqs-2016-005401

University of Ghana http://ugspace.ug.edu.gh

Singh, H., Thomas, E., Khan, M. M., & Peterson, L. A. (2019). Identifying Diagnostic Errors in Primary Care Using an Electronic Screening Algorithm. *Arch Intern Med*, 167, 302–308.

Siu, J. Y. (2015). Communicating under medical patriarchy: gendered doctor-patient communication between female patients with overactive bladder and male urologists in Hong Kong. *BMC Women's Health* (2015), 15(44). https://doi.org/10.1186/s12905-015-0203-4

Slawomirski, L., Auraaen, A., & Klazinga, N. (2017). The economics of patient safety: Strengthening a value-based approach to reducing patient harm at national level. Paris, OECD

Sleath, J. D. (2011). Diseases: on a continuum rather than discrete entities. *BMJ*, *342*. doi: https://doi.org/10.1136/bmj.d3363

Smith, J. (2020). The importance of continuous learning in healthcare. *Journal of Medical Education and Training*, 4(2), 45-50

Southern, D. A., Pincus, H. A., Romano, P. S., Burnand, B., Harrison, J. E., Forster, A. J., Moskal, L., Quan, H., Droesler, S. E., Sundararajan, V., Colin, C., Gurevich, Y., Brien, S. E., Kostanjsek, N., Üstün, B., Ghali, W. A., Ghali, W., Pincus, H., Allen, M., … Southern, D. (2016). Enhanced capture of healthcare-related harms and injuries in the 11th revision of the International Classification of Diseases (ICD-11). *International Journal for Quality in Health Care*, 28(1), 136–142. https://doi.org/10.1093/intqhc/mzv099

Spath, P., & DeVane, K. A. (2009). *Introduction to healthcare quality management* (2nd ed.). Chicago, Health Administration Press.

University of Ghana http://ugspace.ug.edu.gh

Sperandei, S. (2014). Understanding logistic regression analysis. *Biochemia Medica*, 24(1), 12–18. https://doi.org/10.11613/BM.2014.003

Spivey, B. E., & McDonald, W. J. (2007). The Measurement of health care performance: A primer from the CMSS. Council of Medical Specialty Societies.

Spooner, L. M., & Pesaturo, K. A. (2013). The Medical Record. In C. D. Lauster & S. B. Srivastava (Eds.), *Fundamental skills for patient care in pharmacy practice* (pp. 37–64). Burlington, MA: Jones & Bartlett Learning.

Ssebuliba, D. M., Ouifki, R., Pretorius, C., Burnett, S. M., Mbonye, M. K., Naikoba, S., Willis, K., & Weaver, M. R. (2017). Evaluating the impact of two training interventions to improve diagnosis and case-management of malaria and pneumonia in Uganda. *Epidemiology and Infection*, 145(1), 194–207. https://doi.org/10.1017/S0950268816002107

Starfield, B. (2011). Point: The Changing Nature of Disease. Medical Care, 49(11), 971–977.

Stausberg, J., Koch, D., Ingenerf, J., & Btzler, M. (2003). Comparing Paper-based with Electronic Patient Records: Lessons Learned during a Study on Diagnosis and Procedure Codes. *Journal of the American Medical Informatics Association*, 10(5), 470–477. https://doi.org/10.1197/jamia.M1290.j

Subedi, D. (2016). Explanatory Sequential Mixed Method Design as the Third Research Community of Knowledge Claim. *American Journal of Educational Research*, 4(7), 570–577. https://doi.org/10.12691/education-4-7-10

University of Ghana http://ugspace.ug.edu.gh

Suzuki, R., Yajima, N., Sakurai, K., Oguro, N., Wakita, T., Thom, D. H., & Kurita, N. (2022). Association of patients' past misdiagnosis experiences with trust in their current physician among Japanese adults. *Journal of General Internal Medicine*, *37*(5), 1115-1121.

Syzdykova, A., Zolfo, M., Diro, E., & Oliveira, J. L. (2017). Open-Source Electronic Health Record Systems for Low-Resource Settings: Systematic Review: *JMIR Medical Informatics*, 5(4), e44. https://doi.org/10.2196/medinform.8131

Taylor, J. R. A. (2010). The handbook of quality and service improvement tools. *NHS Institute for Innovation and Improvement*, London: pp 154-159.

The Health Foundation. (2013). Measuring patient experience: (Issue No 18). London: The Health Foundation

Thorning, D. (2001). The Role of Autopsy in the Prevention of Medical Errors. *Laboratory Medicine*, 32(5), 248–249.

Traber, B., Giardina, D., King, B. J., Ignaczak, A. P., Paull, D. E., Hoeksema, L., Mills, P. D., Neily, J., Hemphill, R. R., & Singh, H. (2013). Root cause analysis reports help identify common factors in delayed diagnosis and treatment of outpatients. Health Affairs, 32(8), 1368–1375. https://doi.org/10.1377/hlthaff.2013.0130

Tracy, S. J. (2013). Sarah J. Tracy, Qualitative Research Methods: Collecting Evidence, Crafting Analysis, Communicating Impact. In 1st Edition (Ed.), *Revija za sociologiju* (Vol. 43, Issue 1). Blackwell Publishing. https://doi.org/10.5613/rzs.43.1.6

Tsugawa, Y., Jena, A. B., Figueroa, J. F., Orav, E. J., Blumenthal, D. M., & Jha, A. K. (2017). Comparison of hospital mortality and readmission rates for medicare patients treated by

University of Ghana http://ugspace.ug.edu.gh

male vs female physicians. *JAMA Internal Medicine*, 177(2), 206–213. https://doi.org/10.1001/jamainternmed.2016.7875

Tukaram, D. V., Khedekar, K., Faizal, F., & Majethia, N. (2016). The Role of Autopsy in Medical Intensive Care Unit: Comparison of Clinical and Postmortem Diagnoses. *Journal of Evolution of Medical and Dental Sciences*, 5(20), 1038–1042. https://doi.org/10.14260/jemds/2016/242

Tunks, E., Bellisimo, A., & Roy, R. (1990). Chronic pain: Psychosocial factors in rehabilitation (E. Tunks, A. Bellissimo, & R. Roy, Eds.; 2nd ed.). Florida: Robert E Krieger Publishing Co.

Turabian, J. L. (2017). Is the meaning of symptoms the same in women and men? *Journal of Womens Health Care*, 6(3), e129. https://doi.org/10.4172/2167-0420.1000e129

Turyamureba, M., Yawe, B. L., & Oryema, J.B., (2023). Health Care Delivery System in Uganda: A review. *Tanzania Journal of Health Research*, *24*(2), 57-64.

U.S. Chamber Institute for Legal Reform. (2018). *Costs and Compensation of the U.S. Tort System. U.S.* Washington, DC: Chamber Institute for Legal Reform.

UBOS. (2019). Gender issues in Uganda: An analysis of gender-based violence, asset ownership and employment. Kampala, Uganda Bureau of Statistics.

UBOS. (2020). Uganda Bureau of Statistics Statistical Abstract 2020. Kampala, Uganda Bureau of Statistics.

Uganda Bureau of Statistics (UBOS) and Inner-City Fund (ICF). (2018). Uganda Demographic and Health Survey 2016. www.DHSprogram.com

University of Ghana http://ugspace.ug.edu.gh

UNCST. (2014). *National guidelines for research involving humans as research Participants*. Kampala: Uganda National Council of Science and Technology.

UNCST. (2016). *Research registration and clearance policy and guidelines*. Kampala: Uganda National Council for Science and Technology.

Upadhyay, D. K., Sittig, D. F., Quality, H., Singh, H., Debakey, M. E., & Affairs, V. (2015). Ebola US Patient Zero: lessons on misdiagnosis and effective use of electronic health records. *Diagnosis*, 1(4), 1–7. https://doi.org/10.1515/dx-2014-0064

Vaismoradi, M., D, P., Ms, N., Bs, N., Turunen, H., D, P., Bondas, T., & D, P. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing and Health Sciences*, 15, 398–405. https://doi.org/10.1111/nhs.12048

Valderas, J. M., Starfi, B., & Sibbald, B. (2009). Understanding Health and Health Services. *Annals of Family Medicine*, 7(4), 357–363. https://doi.org/10.1370/afm.983

van den Berge, K., & Mamede, S. (2013). Cognitive diagnostic error in internal medicine. *European Journal of Internal Medicine*, *24*(6), 525-529. https://doi.org/10.1016/j.ejim.2013.03.006

Van Melle, M. A., Zwart, D. L. M., Poldervaart, J. M., Verkerk, O. J., Langelaan, M., Van Stel, H. F., & De Wit, N. J. (2018). Validity and reliability of a medical record review method identifying transitional patient safety incidents in merged primary and secondary care patients' records. *BMJ Open*, 8(8), 1–8. https://doi.org/10.1136/bmjopen-2017-018576

University of Ghana http://ugspace.ug.edu.gh

Vassar, M., & Holzmann, M. (2013). The retrospective chart review: important methodological considerations. *Journal of Educational Evaluation for Health Professions*, 10(12). https://doi.org/10.3352/jeehp.2013.10.12

Wachter, R. M. (2014). Diagnostic errors: central to patient safety, yet still in the periphery of safety's radar screen. *Diagnosis*, 1(1), 19–21. https://doi.org/10.1515/dx-2013-0035

Wagner, A., Radionova, N., Rieger, M. A., & Siegel, A. (2019). Patient education and continuing medical education to promote shared decision-making. A systematic literature reviews. *International Journal of Environmental Research and Public Health*, 16(14), 2482. https://doi.org/10.3390/ijerph16142482

Walsh, D., & Evans, K. (2014). Critical realism: An important theoretical perspective for midwifery research. *Midwifery*, 30(1), e1–e6. https://doi.org/10.1016/j.midw.2013.09.002

Wang, Z., Li, N., Jiang, M., & Hsieh, C. (2017). Records of medical malpractice litigation: a potential indicator of health-care quality in China. *Bulletin of the World Health Organization*, 95(8), 430–436.

Weingart, S. N., Davis, R. B., Palmer, R. H., Hamel, M. B., Mukamal, K., Phillips, R. S., Davies, D. T., & Iezzoni, L. I. (2002). Discrepancies Between Explicit and Implicit Review: Physician and Nurse Assessments of Complications and Quality. *Health Services Research*, 37(2), 483–498.

Weiss, P., Kryger, M., & Knauert, M. (2016). Impact of extended duty hours on medical trainees. *Sleep Health*, 2(4), 309–315. https://doi.org/10.1016/j.sleh.2016.08.003

University of Ghana http://ugspace.ug.edu.gh

Whicher D, Rosengren K, Siddiqi S, Simpson L, (2018). The Future of Health Services Research: Advancing Health Systems Research and Practice in the United States. Washington (DC): National Academies Press (US); PMID: 30640418

White, N. J., Watson, J. A., Uyoga, S., Williams, T. N., & Maitland, K. M. (2022). Substantial misdiagnosis of severe malaria in African children. *The Lancet*, 400 (10355), 807. https://doi.org/10.1016/S0140-6736(22)01600-2

WHO. (2016). Diagnostic Errors: Technical Series on Safer Primary Care. Geneva: World Health Organization

WHO. (2017). International Classification of Diseases for Mortality and Morbidity Statistics (ICD-11 Reference Guide Draft 2017-10-09). Geneva: World Health Organization

Wiggins, M. W. (2015). Diagnostic Expertise in Organizational Environments. Surrey: Ashgate Publishing.

Wilson, J., & Bock, A. (2012). The benefit of using both claims' data and electronic medical record data in health care analysis. *Optum White Paper*, Minnesota: Optum Insight, 1-4.

Wilson, M. L., Flaming, K. A., Kuti, M. A., Lai, M. L., Lago, N., & Ru, K. (2018). Access to pathology and laboratory medicine services: a crucial gap. *The Lancet*, 391(10133), 1927–1938.

Wilson, R. M., Michel, P., Olsen, S., Gibberd, R. W., Vincent, C., El-Assady, R., Rasslan, O., Qsous, S., Macharia, W. M., Sahel, A., Whittaker, S., Abdo-Ali, M., Letaief, M., Ahmed, N. A., Abdellatif, A., & Larizgotia, I. (2012). Patient safety in developing countries:

University of Ghana http://ugspace.ug.edu.gh

retrospective estimation of scale and nature of harm to patients. *BMJ,* 832, e832. https://doi.org/10.1136/bmj.e832

Winters, B., Custer, J., Jr, S. M. G., Colantuoni, E., Kapoor, S. G., Lee, H., Goode, V., Robinson, K., Nakhasi, A., Pronovost, P., & Newman-toker, D. (2012a). Diagnostic errors in the intensive care unit: a systematic review of autopsy studies. *BMJ Quality & Safety,* 21(11), 894–902. https://doi.org/10.1136/bmjqs-2012-000803

Worster, A., & Haines, T. (2004). Advanced statistics: understanding medical record review (MRR) studies. *Academic Emergency Medicine*, *11*(2), 187-192. https://doi.org/10.1197/j.aem.2003.03.002

Wu, Y., Bardey, D., Chen, Y., & Li, S. (2021). Health care insurance policies when the provider and patient may collude. *Health Economics*, 30(3), 525–543. https://doi.org/10.1002/hec.4206

Wynants, L., Collins, G. S., & Van Calster, B. (2017). Key steps and common pitfalls in developing and validating risk models. *BJOG: An International Journal of Obstetrics & Gynaecology*, *124*(3), 423-432. https://doi.org/10.1111/1471-0528.14170

Wynn, D. J., & Williams, C. K. (2012). Principles for Conducting Critical Realist Case Study Research in Information Systems. *MIS Quarterly*, 36(3), 787–810. https://www.jstor.org/stable/41703481

Yadav, H., Shah, D., Sayed, S., Horton, S., & Schroeder, L. F. (2021). Availability of essential diagnostics in ten low-income and middle-income countries: results from national health facility surveys. *The Lancet Global Health*, *9*(11), e1553-e1560.

University of Ghana http://ugspace.ug.edu.gh

Yin, R. K. (2014). Case study research design and methods (5th ed., Vol. 28, Issue March 2016). Thousand Oaks, CA: Sage. 282 pages. https://doi.org/10.3138/CJPE.BR-240

Youngberg, B. J. (2016). Top ten emerging risks in health care. Beecher Carlson, 1–6.

Yu, A., Flott, K., Chainani, N., Fontana, G., & Darzi, A. (2016). Patient safety 2030. *London: NIHR Imperial Patient Safety Translational Research Centre*, *45*.

Zsifkovits, J., Zuba, M., & Glebler, W. (2016). Costs of unsafe care and cost effectiveness of patient safety programmes. *European Union*, 385(4), 2116.

Zwaan, L., & Singh, H. (2015). The challenges in defining and measuring diagnostic error. *Diagnosis*, 2(2), 97–103. https://doi.org/10.1515/dx-2014-0069

Zwaan, L., Maude, J., Lyratzopoulos, G., & ten Berg, M. (2016). Diagnostic Error in Medicine 1st European Conference June 30–July 1, 2016. *Diagnosis*, 3(2), eA1–eA36. https://doi.org/10.1515/dx-2016-0015

Zwaan, L., Schiff, G. D., & Singh, H. (2013). Advancing the research agenda for diagnostic error reduction. *BMJ Quality and Safety*, 22(Suppl 2), ii52–ii57. https://doi.org/10.1136/bmjqs-2012-001624

Zwaan, L., Thijs, A., Wagner, C., Wal, G. Van Der, & Timmermans, D. R. M. (2009). Design of a study on suboptimal cognitive acts in the diagnostic process, the effect on patient outcomes and the influence of workload, fatigue and experience of physician. *BMC Health Services Research*, 8, 1–8. https://doi.org/10.1186/1472-6963-9-65

APPENDICES

Appendix A. The ICD-11 coding of the initial and final diagnoses for the misdiagnosed patients (n=223)

Initial (wrong) diagnosis	Final (right diagnosis)	Initial (wrong) diagnosis	Final (right diagnosis)
1. QA1C	MG24.1	111.DA42.Z; MB24.3	1A40.Z
2. MA15.0; FA20.Z	8B20	112.MG40.Z	MG45.Z
3. 1F40.Y, 1A07.Z, MA15.0, DA61	GB51	113.CA40.Z; 1B70.Z; FA05	CA22.Z; BD10&XT5R; 8A61.3Y
4. 1F40.Y; DA42.Z	1A07.Z; DA61; 1A40.Z	114.FA8Z; CA45; MF50.2Y	FA80.9; CA20.Z;5B81.01
5. QA1C	1B95	115.QA1C	MB21.4; 3A9Z
6. 1A90; AA8Z XT5R	1E91.Z; 1C62.3; 1F2Z	116.CA20.Z; GCO8.Z	1B10.1; 3A9Z; 5B54
7. IC62.Z	GA90	117.BC4Z; DA61	BD10
8. 1A40.Z	1A1Z	118.GB01.1	GC00.Z; GB02.Z
9. CA23	CA22.0	119.QA1C	8A80.Z
10. QA1C	1F40.Z	120.GB41; BD10	GB40; 9C80.0
11. QA1C	5A41; 6A70.Z	121.1B98; DA61; DA42.Z, 4A84.Z	1F57.Z
12. GA05.Z, GC00.Z	GCO8.Z	122.QA1C	5B7Z; 1B10.0; 5C70.0
13. CA40.07	1B10.0	123.QA1C	CA40.Z&XT6S&XY69
14. PA78&XE11V	1B70.Z	124.MD81.3; ME24.90; 1B12.7	1A40.Z; DC50.0
15. QA1C	DC12.Z&XT8W	125.QA1C	1E50.1; DA61
16. QA1C	1A40.Z	126.QA1C	8B20; BA00.Z
17. BD11.0	BD13	127.GCO8.Z; GB51	GC00.Z
18. QA1C	1F40.Y	128.1A40.0	ME05.1
19. QA1C	1F40.Y	129.AB0Z	AA91.Z
20. QA1C	5A41	130.QA1C	MA15.0
21. QA1C	1F40.Y	131.3A9Z	8B20; 8A6Z
22. 3A9Z	DA61	132.BD1Z	5DOY; BA00.Z
23. DA61; 1F40.Y	1A07.Z; 1B95; CA45	133.6C40.3; 5C70.0	5B5A.10; 5C70.0; CA40.Z
24. QA1C	DA61	134.GCO8.Z	1F40.Y
25. QA1C	MA15.0	135.QA1C	1F45; GC00.Z
26. 1F45; GCO8.Z	1B10.1	136.QA1C	DA61
27. QA1C	CA40.Z&XT6S&XY69	137.1F45	GCO8.Z
28. 1F40.Y; 1A07.Z; 1E50.Z	GB51	138.1F45	1A40.Z
29. 6B01; 6C20.Z	6B60.Z	139.1F40.Y	1A40.Z; BA00.Z
30. NE60	EB13.0	140.QA1C	1F45
31. GB60.Z; 4B40; 2C94.Z	GB61.Z	141.CA22.Z	DA61

32. ME84.2Z; DA61; NB9Z	FA8Z	142.QA1C	1A07.Z; 3A9Z
33. BC20.1; BB01.Z	BD11.Z	143.1B10.Z	CA40.Z
34. 1C62.Z	1C62.3	144.1A1Z	DA61
35. 1F45; 1C41; 1A36.00; 1A07.Z	BA00.Z	145.DA42.7	1F45; DA61
36. 1A07.Z	DC50.Z	146.6C40.3; 3A9Z	NA0Z; 6C40.3
37. 1B10.1	CA40.Z&XT6S&XY69	147.QA1C	1F40.Y
38. 1A40.0	1A07.Z	148.QA1C	1F40.Y
39. QA1C	IF40.Z	149.CA45	1B10.1
40. GA05.Z	DA61	150.3A9Z	5A21.Z; BA00.Z
41. MA15.0	DA61	151.8C01.3; FA92.Z	FA2Z; GCO8.Z
42. 1F45; 5A41	6A20.0Z; 8A6Z	152.CA40.Z	GC00.Z; 3A9Z; ME05.0
43. QA1C	BA00.Z	153.BA00.Z; 8C0Z	BA01
44. DA61	1B95	154.6A2Z; 5A14	BA03; 5A14
45. 1A40.Z; DA61	DA42.Z	155.BD10; CA20.Z	BA6Z
46. QA1C	DA61	156.GB6Z; DA61; 5B5A	1A40.Z; 1A07.Z; DB94.Z; MA18.0
47. 6C4Z	6C4G.70; BA00.Z	157.DA42.Z	DA61; 1A07.Z
48. QA1C	6D10.Z	158.1F45; MA15.0	1B10.1; 1F23.0
49. QA1C	5A14	159.CA45	GB6Z; GB61.Z; DA61
50. 8A68.Z	8A6Z	160.6C2Z	1A40.Z; 6A2Z
51. QA1C	1F45	161.QA1C	1A40.Z; CA09.Z
52. QA1C	GCO8.Z; FA92.Z	162.QA1C	ME05.1
53. 5A14; BA00.Z; BC4Z	5A21.0	163.QA1C	CA40.Z&XT65
54. 4A84.Z	CA71.0	164.1B40.Z	1A07.Z
55. 2C13.0	DD71.Z	165.DA61	6A60.9
56. 1F40; CA71.0; 5A22.Z	CA40.Z&XT65	166.1F40.Y; MA15.0	FA8Z
57. DA61; BA00.Z; 3A9Z	GB5Y	167.1F40.Y	MA15.Y
58. BA00.Z; 1F45	BD90.Y	168.8B20; MA15.0	5A41
59. CA40.Z	8C03.0; BA00.Z	169.DA61	1C41
60. 1F40	1A07.Z	170.1B10.1; BD10	BA01; CA07.0
61. CA40.Z	CA22.Z; 1B70.Z	171.5C70.0; 1B10.1	CA45
62. QA1C	1A07.Z	172.5C70.0; 1C41	1A40.Z
63. CA45; 5C70.0	1A07.Z; CA40.Z; 1A40.Z	173.CA40.Z; CB03.4	MD11.6
64. BD10; GC2Z; DB98.7Z	BD13; BB01.5	174.MC81.2	6D71; BD11.Z
65. 1D01.10	GCO8.Z; 8B42; 1A07.Z	175.DA61	DA42.Z; 1E90.0
66. 5B7Z; 5C70.0	5B52&XS25; 1A40.Z	176.CA40.Z; 1C60.Z	1C62.3; 3A9Z
67. QA1C	1A40.Z	177.BD10	MA15.Y
68. 5A11	DA42.Z; GCO8.Z; 1F45	178.CA07.0; 1F23.0	CA40.Z; DA61

69. MB24.5	1A62.0; 2B31.20	179.CA07.0	BA00.Z; CA40.Z; GCO8.Z; 1A07.Z
70. CA23.30	CB03.Z	180.ME05.1	1A40.Z; DA61
71. MG45.Z;1F45; GCO8.Z	DA22.Z; DA61	181.6D85.3; 1B10.1	1D01.10; CA07.0
72. BA00.Z	BE2Y	182.DA61; 1A07.Z; DB94.3	DB94.3; 3A9Z; GCO8.Z
73. 6C40.Z; 5A14	1C8E; 5A21.Z	183.CA40.Z; 1B10.1	CA07.0; 6A60.9
74. CA20.1Z; 8B20	CA22.Z	184.5A11; DA42.Z	GCO8.Z; DA61
75. MA15.Y; 1B10.1	DA42.82	185.5A11	DA61
76. MA15.Y	BD10	186.CA07.0; 5C70.0	CA40.Z
77. QA1C	GCO8.Z	187.1A07.Z	MA15.0
78. 1C41	8A80.Z; MA15.Y	188.DA61	DC50.Z
79. 3A9Z	MD31; DA61	189.QA1C	1F40.0
80. DA42.Z; CA07.0; 1B10.1	PD03	190.QA1C	1B10.1
81. QA1C	QA14	191.1A40.Z; MA15.0	ME24.9Z
82. 4B23; 1B10.1; GCO8.Z	CA40.Z	192.6A20.Z	9C83.13
83. CA40.Z	BD10	193.MA15.0	MA15.Y
84. CA45; 5C70.0	MA15.Y	194.BA00.Z	BD10
85. 5C70.0; 5B52&XS25	DA22.Z	195.GC00.Z	ME10.02
86. MD81.3	DA61	196.QA1C	2C77.Z
87. QA1C	MA15.Y	197.CA23.30	1B10.1
88. 1C41; DA42.Z	CA45	198.BA00.Z; DA61; CA40.Z; CB27	BA01; 5A11; CA22.Z
89. MA15.0	MA15.Y	199.MA15.0	5A11
90. QA1C	MG22	200.DA61	BA03
91. 1C62.Z; 1F23.2; CA07.0	CA45; 1D01.10, 1B10.1	201.MG40.Z	1F40.0
92. DA61; DB93.1	DB95.Z	202.MF50.3; 1A6Z	BE2Y
93. CA07.0	MA15.0	203.BE2Y; 1F40; CA40.Z	1F57.Z
94. 3A51.2	1F40.0; GCO8.Z	204.MA15.0	1D01.10
95. KA60	KB8Z	205.5A11	MA15.0
96. MA15.Y	KA87.Y	206.5A11	DA42.Z
97. MA15.Y	KB06	207.8A81.Z	6A7Z
98. DA61; BA2ZZ; 3A9Z&XS25	2B33.1	208.CA07.0	5B7Z
99. GB40	GB61.Z	209.GB40	BD10
100.QA1C	CA40.Z	210.1C62.Z	6D85.3
101.DA61; 1C41; CA07.0; GCO8.Z	8B42	211.5C70.0	8B20
102.MC81.2	BD10	212.QA1C	1F45
103.QA1C	CA45	213.1F40.Y	5C70.0; 3A9Z
104.ME05.1; 5B7Z	GB61.Z; 1A40.Z	214.1A07.Z	1E50.Z
105.ME04.Z	BD10	215.GB02.Z; GCO8.Z	1A6Z

106.1F40.Y	GB51	216.CA00	CA08.1Z
107.5A11	5B57.Z	217.QA1C	MA15.0
108.MA15.0	1D01.10	218.GB40	GB61.Z
109.QA1C	1A40.Z	219.QA1C	CA40.Z
110.1A07.Z	GA34.3	220.DA61; 1C41; CA07.0; GCO8.Z	8B42
111.3A9Z&XS25	3B4Z	221.MC81.2	BD10
112.MA15.0	CA22.Z	222.MC81.2	6D71; BD11.Z
113.QA1C	1F23.0	223.4A8	CA71.0

University of Ghana http://ugspace.ug.edu.gh

APPENDICES
SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA

Appendix B: Consent Form for In-Depth Interview

TITLE: STRENGTHENING HEALTH SYSTEMS FOR QUALITY HEALTH CARE: CASE STUDY OF MISDIAGNOSIS AMONG HOSPITALIZED PATIENTS IN GENERAL HOSPITALS IN UGANDA

Please take time to understand the following after which you may make an informed decision on whether to or not participate in this research as a respondent

Introduction

I am Simon Peter Katongole, a PhD Candidate of health policy, planning and management at the University of Ghana Legon. I am currently undertaking my research on a topic titled "The burden of misdiagnosis in general hospitals of Uganda". I am asking you to participate because you are highly informed about the diagnostic processes in the hospitals. I will carefully read to you this form and please feel free to ask questions before you formally agree to take part in this study.

Purpose of the research: This research is being undertaken as part of the requirements necessary to complete PhD studies at the University of Ghana Legon. I am seeking to examine health system factors associated with misdiagnosis for improving health care quality in general hospitals in Uganda and establish the financial cost of misdiagnosis to the hospitals. This research is self-sponsored and is not meant for service provision. This study has been approved by an accredited research ethics committee

What you will do in this research: Should you accept being part of this research, you will participate in interviews where you will be asked questions pertaining misdiagnosing of patients in the hospital. Since this interview will be conducted via phone, I ask for your permission to record it so that I do not have to write notes during the interviews to save time as well as be in position to revert back to the recording in order to transcribe the interview.

Participants: Twenty (20) frontline health workers (six (6) medical officers and fourteen (14) clinical officers will participate in these interviews.

Time required: The interview will take approximately thirty (30) to forty-five (45)

Risks: Your participation in this study poses no risk to you.

Benefits: Your views in this research will guide the researcher to make pertinent recommendations that may contribute to the improvement of the diagnostic process in Ugandan hospitals.

Compensation: I will not be compensating you in any way at the end of this interview.

University of Ghana http://ugspace.ug.edu.gh

Confidentiality: Your identity in the writing of the results will not be revealed rather your position will be used without revealing your address. Your name will rather be written on the transcription for easy tracking should need for clarification on information provided arise. All transcripts will be kept by the researcher and will not be shared out to anyone save for the supervisors only when asked. Recordings of this study will be kept by the research in tools that require a password which is only known to the researcher. For any conference presentations, manuscripts written and eventual articles published out of this interview, your name will not be published or used anywhere.

Participation and withdrawal: Your participation in this study is voluntary and you are free to withdraw from the study at any time. You may also decline to answer any of the question but continue participating in this interview.

Feedback about the research: As a participant, you will get feedback on the progress and the findings of the study

Whom to contact about your rights in this research: The researcher conducting this study is Katongole Simon Peter. Should you be having any concerns questions, concerns, suggestions, or complaints regarding this study or research-related harm please contact him on +256702830019/+256782830019 or via email at spkatongole@gmail.com

Should you want to know about you rights and welfare, please you can contact the MUREC

Chairperson, Ms. Nakubulwa Susan on 0392174236

Statement of Consent

I have understood the information explained to me above and all questions I asked regarding this study have been answered. I therefore consent to participate in this study.

Participant/respondent Signature ___________________________ Date ____________________
Respondent's/participant's Name (written) ____ I too consent to having this interview sound recorded

Your Signature ____________________________________ Date __________________________
Signature of person obtaining consent ______________________ Date _____________________

Written name of person obtaining consent ………………………….. Date ………………………

University of Ghana http://ugspace.ug.edu.gh

APPENDICES
SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA

Appendix C: Data extraction form

Data item		Data entry field
Patient identification no (admission no)		………………………………………… …
Patient's age		……………………………………
Patient's gender		…………………………..
Patient's referral status	1. Referred in from lower H/C 2. Self-referral	
Duration of sickness	1. Acute (Less than 2 weeks) 2. Chronic (more than two weeks	
1. New case (reporting for the first time with the present illness in the current month) 2. Old case (been to hospital in the last one month for same illness)		
Where laboratory tests done prior to admission		1. Yes 2. No
How many tests/investigations were conducted on the patient		3.
If yes in the question above, where the results from the laboratory form used for any of the diagnosis made		1. Yes 2. No
Admission history		
Presenting signs and symptoms	1…………………………………………… 2. ……………………………………… 3. …………………………………….. 4.………………………………………….	
Diagnosis made at admission	1. Primary diagnosis ………………………………………… 2. Secondly diagnosis ………………………………………… 3. Any other diagnosis …………………………………………	
Number of diagnoses at admission (Count from above)	a) 1………………. b) 2…………….... c) 3……………….	
Presence of comorbidity	1. Yes………………… 2. No…………………	
What day shift (Time) was the patient admitted in the hospital?	1. Day time (7am-4pm) 2. 5-10pm 3. Night (11pm-6am)	SHIFTADM
Number of patients seen on the shift		
Weekday of admission	1. Weekend (Saturday Sunday) 2. Monday and Tuesday 3. Wednesday to Friday	WEEKDAYADM

University of Ghana http://ugspace.ug.edu.gh

What is the qualification of the admitting health worker?	**1.** Clinical Officer **2.** Nurse other (Specify)	QUALIDIAGNO
Experience of admitting diagnostician	1. ≤5 years 2. >5 years	ADMDIAEXPR
Gender of admitting clinician	1. Male 2. Female	ADMDIAGEN

Investigation and Treatment history		
List all laboratory investigations carried out	1. …………………………………………………………………….. 2. …………………………………………………………………….. 3. …………………………………………………………………….. 4. ……………………………………………………………………	
List all radiology investigations carried out	1. ……………………………………………………………………….... 2. ………………………………………………………………………. 3. ………………………………………………………………………. 4. ……………………………………………………………………….	
List all treatment prescribed (Write as prescribed, i.e., drug name, dose, duration)	1. ……………………………………………………………………….. 2. ……………………………………………………………………….. 3. ……………………………………………………………………….. 4. ……………………………………………………………………….. 5. ………………………………………………………………………..	
List all treatment given by the hospital (Write as dispensed, i.e., drug name, dose, duration)	1. ……………………………………………………………………….. 2. ……………………………………………………………………….. 3. ……………………………………………………………………….. 4. ……………………………………………………………………….. 5. ………………………………………………………………………..	
List all treatment given purchased by the patient	1. ……………………………………………………………………….. 2. ……………………………………………………………………….. 3. ………………………………………………………………………..	
List any drug(s) that were withdrawn along the course of treatment		
For any drug(s)withdrawn after prescription, identify in doses (amount) how much had been consumed		
Discharge diagnosis(es)	Disease	ICD-11 code
	1.	
	2.	
	3.	

University of Ghana http://ugspace.ug.edu.gh

APPENDICES
SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA

Appendix D: Semi-structured (In-depth) Interview guide for health workers/diagnosticians

TITLE: Strengthening health systems for quality health care: case study of misdiagnosis among hospitalized patients in general hospitals in Uganda

I would like to thank you for accepting my request to meet me today and have an interview with you. I am Simon Peter Katongole, a PhD Candidate at the University of Ghana Legon currently undertaking my research on a topic titled "The burden of misdiagnosis in general hospitals of Uganda". As part of this PhD research, I am assessing the prevalence of misdiagnosis, classify the diseases misdiagnosed, establish factors that could predict the occurrence of misdiagnosis and cost the burden of misdiagnosis to the hospitals. I, therefore, will interview you on issues pertaining factors that could lead to patients being misdiagnosed.

Purpose Specifically, I am investigating the problem of misdiagnosis in hospitals to determine how big it is and why it is occurring. I am also trying to establish how much the hospitals and the health system at large lose financially when misdiagnosis occurs. Lessons from my PhD studies will help me write and complete my dissertation as a requirement for the award of a PhD in Public Health specializing in health policy, planning and management. The publications that will come out of this study will more likely bring to the attention of health practitioners, managers, policy makers on the misdiagnosis burden and perhaps influence them to give it the attention deserves.

This interview will take approximately one hour. It will be tape recorded in order to be able to capture all information and comments that would be missed by only depending on the written notes. I have a research assistant who is taking notes during the session since I can hardly interview and at the same time write fast enough without missing some information. I therefore request you to be audible enough to enable us capture all the information we need

I promise to keep all the information confidential in a way that this information can only be shared with my research supervisors. None of this information will bear your name and all efforts will be put to safeguard any information I will use in the report writing cannot be traced to you. In the event that you are not comfortable to talk about any issue, you deserve the right to decline saying it and your decision will be respected. You are free to seek clarification where need be for any question posed to you. At the same time, it is not a must to talk about everything hence you may end the interview when you feel like.

Do you have any question related to what has been clarified to you?

Will you partake in this study? ___________________

___________________ Interviewee ____Witness

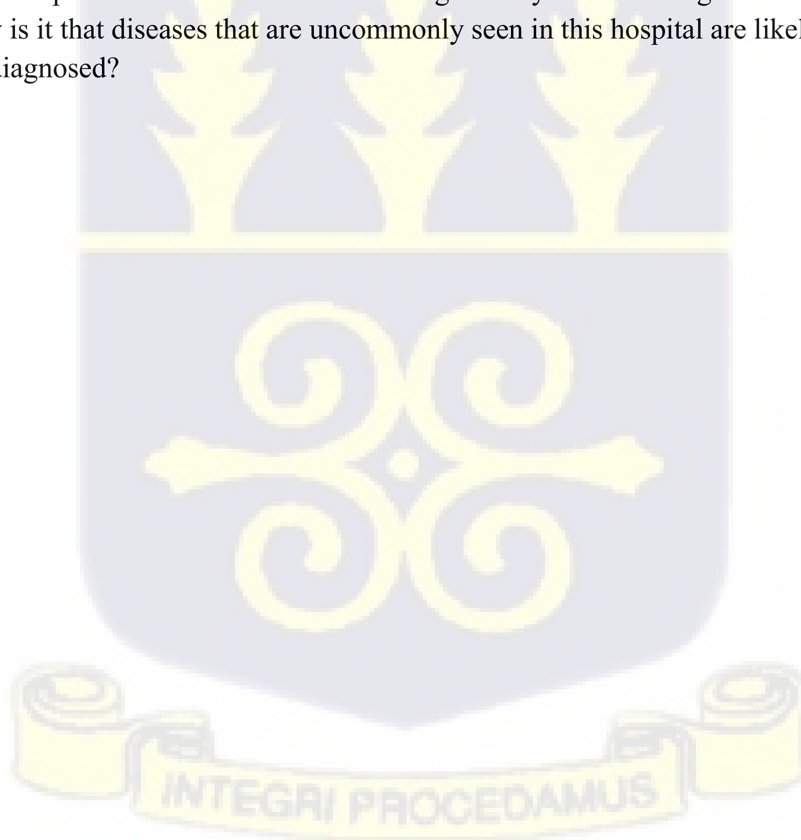
University of Ghana http://ugspace.ug.edu.gh

Date

Interviewee ……………………………………………………………….

How long have you been working as a (doctor, a clinician here)?

1. In you view, could you please describe how big the challenge of misdiagnosis is in this hospital?
2. What are some of the factors that predispose/lead to patients being misdiagnosed?
3. Why do you think the following factors are likely to be associated with misdiagnosis of patients?
   a. Mention characteristics of patients that quantitative results identified would be more likely to be misdiagnosed the week be misdiagnosed?
      i. What factors in this hospital predispose patients to being misdiagnosed?
      ii. Why are older patients likely to be misdiagnosed?
      iii. How is the gender of the patient associated with patient misdiagnosis (probe why men are likely to be much more misdiagnosed)?
      iv. Why are patients who were referred to the hospital were associated with misdiagnosis?
      v. Why are patients with underlying diseases likely to be misdiagnosed?
      vi. Why is it that having multimorbidity may predispose a patient to being misdiagnosed?
      vii. Why are patients who were admitted at night likely to be misdiagnosed?
      viii. Why is it that diseases that are uncommonly seen in this hospital are likely to be misdiagnosed?



University of Ghana http://ugspace.ug.edu.gh

APPENDICES

Appendix E: The major diagnostic ICD-11 grouping classification

01 Certain infectious or parasitic diseases
02 Neoplasms
03 Diseases of the blood or blood-forming organs
04 Diseases of the immune system
05 Endocrine, nutritional or metabolic diseases
06 Mental, behavioural or neurodevelopmental disorders
07 Sleep-wake disorders
08 Diseases of the nervous system
09 Diseases of the visual system
10 Diseases of the ear or mastoid process
11 Diseases of the circulatory system
12 Diseases of the respiratory system
13 Diseases of the digestive system
14 Diseases of the skin
15 Diseases of the musculoskeletal system or connective tissue
16 Diseases of the genital urinary system
17 Conditions related to sexual health
18 Pregnancy, childbirth or the puerperium
19 Certain conditions originating in the perinatal period
20 Developmental anomalies
21 Symptoms, signs or clinical findings, not elsewhere classified
22 Injury, poisoning or certain other consequences of external causes
23 External causes of morbidity or mortality
24 Factors influencing health status or contact with health services
25 Codes for special purposes
26 Traditional Medicine conditions - Module I
V Supplementary section for functioning assessment
X Extension Codes

University of Ghana http://ugspace.ug.edu.gh

APPENDICES
SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA

Appendix F: HMIS form 051: Inpatient Treatment Sheet

Ward …………….. Bed Number ………………… Name ……………………………………………

Inpatient number………………… Address ………………………………… Age ……… Sex ……….
Next of kin information ………………………………….. Admission date ……/………/…………
Time: ………………….. Referred from ……………………………….. Discharge date: ……/……/……
Status of discharge: ……………………………… Final diagnoses: …………………………………
Surgical procedure, special services: ………………………………… If follow-up needed after discharge, date: ………/……../………. Place: …………………………………………………………………….

Treatment instructions after discharge: ……………………………………………………………
CLINICAL NOTES:
……
……
……
……
……
……
……
……
……
……
……
……
……
Provisional
……

LABORATORY AND X-RAY FINDINGS:
……
……
……
……
……
……
……
……
……
……
……
……
……

University of Ghana http://ugspace.ug.edu.gh

APPENDICES
SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA

Appendix G: HMIS form 052: Inpatient Discharge Form

DESCRIPTION AND INSTRUCTIONS

Objective: Reference information for patient to retain about his/her hospital stay

Timing: Whenever a patient is being discharged from a health facility.

Copies: One goes with patient

Responsibility: Doctor/Clinician/Ward In charge.

PROCEDURE:

1. The DISCHARGE NOTE has the same format as the administrative part of the INPATIENT TREATMENT SHEET. If not available a MF 5 form can be used to record this information.

2. Side 1 is completed when the inpatient is discharged. If the doctor or nurse wishes to add more detail to this information, side 2 can be used. During continuing treatment, Side 2 is completed.

3. It is important that the patient immunizes that s/he should bring the note whenever s/he requires medical attention in the coming months. The DISCHARGE NOTE should then be attached to the patient's OUTPATIENT CARD MF 5.

4. When the patient is immunized for a new period, the discharge note is used to retrieve the old file. At the place where the old file was taken, put a blank sheet with the following reference information: Inpatient Number of the old file, Name of the patient and the New Inpatient Number. In this way it is known that the old file is not lost and where to find it. At discharge the old file is stapled / attached to the new file and they are filed under the new Inpatient Number.

Ward ………………….. Inpatient No. ………. Name …………………………. Age ………
Sex ……… Address ………………….. Date of Admission ………………. …… ……………..
Date of Discharge ………………….. Status on discharge ……………………………………..

Provisional Diagnosis ……………………………….. Final diagnosis …………………………...

Clinical Presentation of Patient
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

University of Ghana http://ugspace.ug.edu.gh

……
……
……
……
……
……
……
……
………………………………………………………………………………………………………
……
……

Summary of intervention given (Investigation, treatment and surgical procedure)

……
……
………………………………………………………………………………………………………...
……
……
……
……
……

Recommendation on Discharge …………………………………………………………………

Name and Designation of discharging officer

……

Date of follow-up ………………………………………………………………………………..

Place ………………………………………………………………………………………….

University of Ghana http://ugspace.ug.edu.gh

APPENDICES
SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA

Appendix H: HMIS Form 054: Inpatient Register

HEADINGS AND COLUMN WIDTHS:

LEFT SIDE

1	2	3		4	5	6	7	8	9	10
IPD NUM	NAME	RESIDENCE		AGE	SEX	NEXT OF KIN	REF IN?	REFERRED FROM	DATE IN	DATE OUT
		VILLAGE	PARISH							
2 cm	3.5 cm	4 cm	3.5 cm	1 cm	1 cm	3.5 cm	1 cm		2 cm	2 cm

RIGHT SIDE (11)

11	12	13					14
Provisional diagnosis	Diagnosis at discharge	Final status					Remarks
		D	DD	T	R	S	
7 cm	7 cm						4 cm

DESCRIPTION OF COLUMNS:

1. IPD NUM: This is the unique serial number given to the inpatient during his/ her stay. IPD number begins with 1 at the beginning of the financial year (July) and ends at the end of the financial year (June)
2. NAME: The patient's name
3. RESIDENCE: The patient's village and Parish of residence
4. AGE: The patient's age in complete years if over one year of age. Use months if under one year writing clearly "MTH" after the age. If the patient is less than one month, then "Days" are written after the age
5. SEX: The patient's sex. Use "M" for Male or "F" for Female.
6. NEXT OF KIN: Person responsible in case of follow up or emergency.
7. REF IN?: Put a tick if the patient was referred into the unit.
8. DATE IN: The date the patient was admitted - day and month are sufficient. It is best to use abbreviations (Jan, Feb, Mar, etc.) and not numbers for the month.
9. REFERRED FROM: Indicate the name of health facility or ward referring the patient to this ward or health facility.
10. DATE OUT: The date when the patient was discharged. Day and month are sufficient. It is best to use abbreviations (Jan, Feb, Mar, etc.) and not numbers for the month.
11. PROVISIONAL DIAGNOSIS: From the patient's Outpatient Card or other documentation, write the diagnosis upon admission.
12. DIAGNOSIS AT DISCHARGE: From the INPATIENT TREATMENT SHEET write the FINAL diagnoses. If abbreviations are used, ensure that they are standard and used consistently.

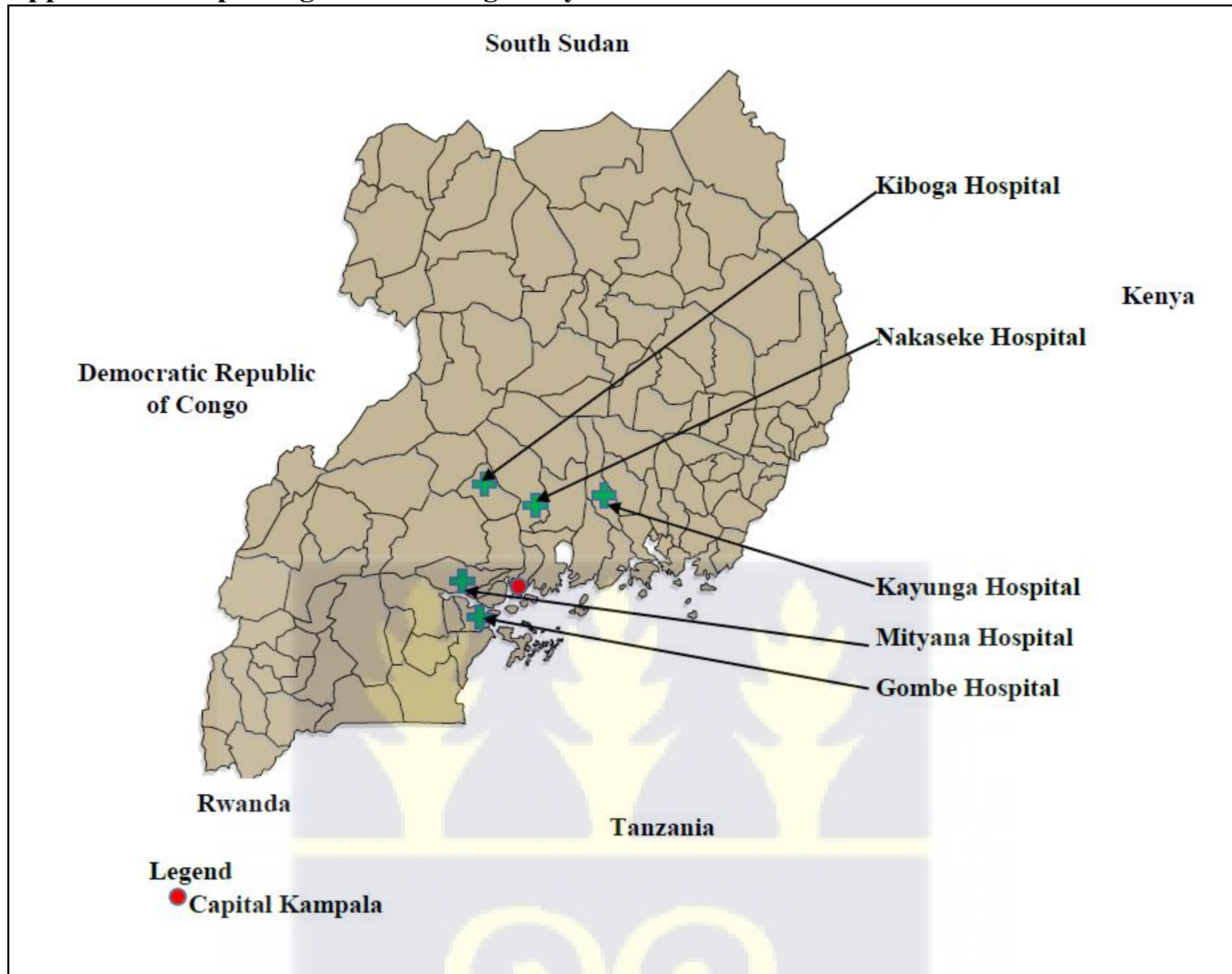
University of Ghana http://ugspace.ug.edu.gh

13. FINAL STATUS: Tick as appropriate: "D" for discharge (this includes the MF 74 categories of recovered, improved and unchanged), "T" for transferred to another ward, "R" for referred out to another health unit, "DD" if the patient died, and "S" for self-discharges/ runaways.
14. REMARKS: This can contain any information of interest to the Medical Superintendent. For diagnosis that result from Injuries, indicate the incident that caused the Injuries (Road Traffic Accident, gunshot, Domestic Violence, Suicide, Poisoning, etc).

University of Ghana http://ugspace.ug.edu.gh

APPENDICES

Appendix I. Map of Uganda showing study location



University of Ghana http://ugspace.ug.edu.gh

APPENDICES

Appendix J. Institution Review Board approval

Research Ethics committee (MUREC)

7 July 2020

Simon Peter Katongole
Principal Investigator

Dear Peter,

Re: Initial approval of your Research protocol: # REC REF 0505-2020 "Strengthening Health Systems for Quality Health Care: Case Study of Misdiagnosis among Hospitalized Patients in General Hospitals in Uganda."

Thank you for submitting this application for approval of the above referenced protocol to MUREC.

I am glad to inform you that approval is hereby given to conduct the study; this approval is given following your exhaustive responses to initial comments raised by MUREC. The approval is for one year, effective 7th July 2020 and will expire on 7th July 2021. Extension beyond this expiry date and changes to the protocol including data collection tools must be brought to the attention of MUREC.

Before you proceed, you are required to submit the protocol to Uganda National Council for Science and Technology (UNCST) for registration.

You are also required to provide progress reports at an annual interval, to notify MUREC on completion, as well as when publishing results.

Please do not hesitate to contact us if you have any questions.

I wish you success in this endeavor.

Yours sincerely,

Susan Nakubulwa
MUREC-Chairperson

Location/ Correspondence
Mildmay,Uganda
Plot 27,Lweza
P.O.Box 24985,Kampala

Communication
Tel: 0392174236
Email:murec@mildmay.or.ug
WWW.mildmay.org/uganda

Guiding Research For the Future

University of Ghana http://ugspace.ug.edu.gh

APPENDICES

Appendix K: Uganda Nation Council of Science and Technology approval

Uganda National Council for Science and Technology

(Established by Act of Parliament of the Republic of Uganda)

Our Ref: HS826ES **21 August 202(**

Simon Peter Katongole
Uganda Martyrs University
Mpigi

Re: Research Approval: **Strengthening health systems for quality health care: case study of misdiagnosis among hospitalized patients in general hospitals in Uganda**

I am pleased to inform you that on **21/08/2020**, the Uganda National Council for Science and Technology (UNCST) approve(the above referenced research project. The Approval of the research project is for the period of **21/08/2020** to **21/08/2021**.

Your research registration number with the UNCST is **HS826ES**. Please, cite this number in all your future correspondences with UNCST in respect of the above research project. As the Principal Investigator of the research project, you are responsible for fulfilling the following requirements of approval:

1. Keeping all co-investigators informed of the status of the research.
2. Submitting all changes, amendments, and addenda to the research protocol or the consent form (where applicable) to the designated Research Ethics Committee (REC) or Lead Agency for re-review and approval prior to the activation of the changes. UNCST must be notified of the approved changes within five working days.
3. For clinical trials, all serious adverse events must be reported promptly to the designated local REC for review with copies to the National Drug Authority and a notification to the UNCST.
4. Unanticipated problems involving risks to research participants or other must be reported promptly to the UNCST. New information that becomes available which could change the risk/benefit ratio must be submitted promptly for UNCST notification after review by the REC.
5. Only approved study procedures are to be implemented. The UNCST may conduct impromptu audits of all study records.
6. An annual progress report and approval letter of continuation from the REC must be submitted electronically to UNCST. Failure to do so may result in termination of the research project.

Please note that this approval includes all study related tools submitted as part of the application as shown below:

No.	Document Title	Language	Version Number	Version Date
1	Consent forms	English	001	31 July 2020
2	Protecting human subjects	English	001	31 July 2020
3	Project Proposal	English	VERSION001	
4	Approval Letter	English	VERSION001	2020-07-31
5	Administrative Clearance	English	VERSION001	2020-07-31