



RESEARCH ARTICLE

Examining the Level of Knowledge, Attitudes, and Practices of Nurses Toward Disease X: Insights From a Cross-Sectional Survey

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ABSTRACT

The World Health Organization has indicated the possibility of the global health system being riddled with a public health threat which could be deadlier than COVID-19 and EVD. This possible disease has been labeled “Disease X”. Since nurses are the health experts in closest proximity at the bedside of the patient, managing Disease X will heavily depend on the role of nurses. This study aimed to investigate the knowledge, attitudes, and practices of Ghanaian nurses about Disease X. The study further examined the predictors of knowledge of Disease X. A cross-sectional survey was conducted among a uniform sample size of 1,127 nurses who had worked in Ghana for at least 1 year. After validation, pilot testing and tests for internal consistency, a structured questionnaire with 4 Sections was used for data collection. The study revealed that nurses have the lowest detected levels of knowledge regarding Disease X, with only a proportion of 25.6% acknowledging its potential zoonotic character. Despite this, most nurses (37.4%) were concerned about contracting the disease, and few (16.5%) believed that current infection control measures were effective. Only 13.7% reported actively preparing for Disease X, and 39.5% reported a lack of specific training. Public sector nurses had higher knowledge levels, and less experienced nurses were more knowledgeable. The findings of the study reveal major discrepancies in the readiness of nurses in a range of aspects of preparedness for Disease X, specifically regarding knowledge and specialized training.

1 | Background

Throughout human history, a variety of illnesses have driven epidemics in many parts of the world, killing millions of people (Huremović 2019). Some of these diseases have subsequently resulted in pandemics, wreaking havoc among health systems globally. Infectious diseases such as Ebola Virus Disease (EVD), Severe Acute Respiratory Syndrome (SARS), and COVID-19 are among such diseases (Das et al. 2023; Nnaji et al. 2021). The emergence and spread of zoonotic infections and new infectious diseases have caused significant disruption in the global health system (Das et al. 2023). This is owing to activities such as land use, climate change, biodiversity and growing global travel and

trade. Notably, the literature suggests that such diseases may still emerge unpredictably (Benjamin et al. 2018).

According to the World Health Organization (WHO), the global health system has never been under greater threat of Disease X, a worse disease that could be more deadly than COVID-19 or EVD (World Health Organization 2024), that is most likely to cause the next pandemic (Citaristi 2022). In the field of public health the term “Disease X” is used as a placeholder for “Disease Unknown” or a newly discovered infectious disease that can cause a serious threat to human health. It represents a significant global outbreak that could result from an unidentified pathogen-causing disease in humans (Ali Al Shehri et al. 2022).

Summary

- The World Health Organization has indicated the probable emergence of another infectious disease of pandemic potential, which could probably be worse than COVID-19 or EVD. This probable infection is termed “Disease X.”
- Although Disease X is increasingly recognized as a potential global health threat, there is a paucity of literature on how healthcare professionals, most especially nurses, in low- and middle-income countries such as Ghana understand and negotiate preventive measures related to this nebulous threat.
- This study revealed that preliminary infection prevention measures are being implemented by a significant number of nurses, yet considerable gaps are evident in preparedness and disease-specific awareness of Disease X, especially among older nurses and nurses working in the private sector. The gap of specific training even for Disease X and the gray area of infection prevention in this study emphasize the urgent need for unique educational programs.

While there is limited research on Disease X globally, studies on knowledge, attitudes, and practices (KAP) regarding other emerging diseases in high-income countries, particularly among physicians and allied health professionals, offer some insights. For instance, studies conducted during the COVID-19 pandemic in the U.S. and UK indicated that even in well-resourced settings, knowledge gaps and inconsistent attitudes among healthcare workers existed initially (Kaye et al. 2020; Garrett 2020). These studies, however, also revealed faster improvements in preparedness due to rapid training programs and clear communication strategies.

In Africa, where infectious diseases such as malaria, HIV/AIDS, and Ebola have historically posed significant challenges, Disease X represents a looming concern (Nii-Trebi et al. 2023). The emergence of Disease X as a new zoonotic infection could be catastrophic to African countries, of which Ghana is no exception. Therefore, it is essential to have preventive measures to strengthen the healthcare system, especially the nursing workforce. This is further imperative because nurses form the largest category of health professionals who are in closest proximity to the patient (Llop-Gironés et al. 2021). Also, nurses have more contact with patients than other health workers in healthcare settings. Due to this, nurses have substantial influence on patient health outcomes (Işık et al. 2022). As nurses will play a critical role in managing Disease X, it is paramount that they possess a thorough understanding, positive attitudes, and accurate practices toward this condition. This will not only improve the quality of care for patients but also ensure an overall reduction in the prevalence and impact of Disease X.

Although Disease X is increasingly recognized as a potential global health threat (Sarkar et al. 2023), there is a paucity of literature on how healthcare professionals, most especially nurses, in low- and middle-income countries such as Ghana understand and negotiate preventive measures related to this nebulous threat. Although some studies have examined healthcare workers' generalized attitudes toward infectious diseases globally or within several large medical facilities in other African countries such as Nigeria (Amaran and

Onwube 2013), none have explicitly investigated how Ghanaian nurses will target Disease X. Also, considering Ghana's recognition of the growing burden of both chronic and infectious diseases and the need for an integrated plan to address these issues (Adesegun et al. 2020; Laar et al. 2019), it is possible that Ghanaian nurses may view Disease X as a potential threat, and they may be motivated to enhance their knowledge and skills to respond to such infectious diseases effectively.

1.1 | Research Objectives

This study aims to investigate the knowledge, attitudes, and practices of Ghanaian nurses toward Disease X and to identify determinants of their level of knowledge toward Disease X.

1.2 | Significance of the Study

Findings of this study aim to guide the development of targeted educational and training programs for Ghanaian nurses and inform public health strategies on Disease X. Moreover, understanding the level of knowledge and practices of nurses is crucial in strengthening disease surveillance, preparedness, and response strategies to mitigate the impact of emerging infectious diseases like Disease X.

2 | Methods

2.1 | Study Design and Sampling

This study employed a cross-sectional design and quantitative approach to examine the knowledge, attitudes, and practices of nurses toward Disease X. The cross-sectional design was selected to capture a snapshot of participants' opinions at a specific time. The research involved a convenience sample of registered nurses working in various healthcare facilities in Ghana.

The inclusion criteria included nurses with a minimum of 1 year of clinical experience and were willing to participate in the study. The 1-year minimum was chosen to ensure participants had foundational clinical experience and sufficient exposure to standard infection control practices in their respective facilities. Data was collected using an online Google-based structured questionnaire. The link to the survey form was shared through WhatsApp and voluntary participation was emphasized.

2.2 | Sample Size Calculation

The sample size was calculated from an unknown population size using the Cochran sample size estimation formula,

$$n_0 = \frac{z^2 * p(1-p)}{e^2}$$

where n_0 is the sample size, e is the desired level of precision, p is the fraction of the population that displays the attribute and z

is the selected critical value of the desired confidence level. In this study, given the lack of information on Disease X, it is assumed 50% of nurses have knowledge about Disease X, a *z*-value of 1.96 at 95% confidence level, and a margin of error of 0.05 were used to reach a sample size of 384. Finally, a non-response rate of 10% was assumed to have a sample size of 422.

2.3 | Instrumentation

Based on literature review on Disease X (Banerjee et al. 2022; Citaristi 2022; Ali Al Shehri et al. 2022), a structured questionnaire was prepared and consisted of four sections: (a) demographic information, (b) knowledge assessment (c) attitudes assessment and (d) practices toward Disease X. The demographic information consisted of sex, age, the years of practice, educational level, category of nurse, and rank. The knowledge section contained 12 questions which assessed the participants' knowledge in the etiology and transmission mode. The attitude section was made up of 8 questions to measure the attitude of nurses on Disease X, and the last part of the questionnaire assessed the practice of nurses on Disease X prevention.

Before pilot testing, the questionnaire underwent face and content validity assessments by three public health and nursing experts. Revisions were made to ensure the relevance and clarity of items. Scoring for the knowledge section was based on correct answers (1 = correct, 0 = incorrect). Attitude and practice responses used a 5-point Likert scale (Strongly Disagree to Strongly Agree).

2.4 | Pilot Testing and Data Collection

To ensure the reliability and validity of the research instrument, the questionnaire was pilot tested on a group of 30 nurses who were not participants in the main study. The research instrument achieved a Cronbach's Alpha Coefficient of 0.73. This reflected a fair degree of internal consistency with the instrument. Responses from the pilot test were used to finalize the questionnaire. The data were collected via an online survey between January 10 and October 1, 2024. Before participating, the respondents were informed about the purpose, voluntary nature, and confidentiality of the study. Before completion of the questionnaire, participants provided informed consent.

2.5 | Data Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) software. Participants' sociodemographic characteristics and responses on their level of knowledge, attitudes and practices toward Disease X were summarized using descriptive statistics such as frequencies and percentages, while a multiple linear regression model was fitted to determine the factors influencing the level of knowledge of the nurses on Disease X. Variables in the regression model were selected based on theoretical relevance and prior literature on KAP studies (Harries et al. 2020). Assumptions of normality, multicollinearity, and homoscedasticity were checked. The model included sector, nursing rank, years of practice, qualification,

sex, and age. These variables were included a priori due to their known influence on KAP in health-related research (Garrett 2020).

2.6 | Ethical Considerations

Before initiating this study, ethical approval to conduct the study was sought from the University of Education, Winneba Ethical Review Board (UEWERB). The ethical clearance number was UEWC/26. The study also adhered to all ethical guidelines regarding conducting research with human participants in the following ways.

2.7 | Informed Consent and Voluntary Participation

Participants were informed that participation was voluntary. They were also provided with full knowledge of the research's purpose, procedures, risks, benefits, and their rights. They were also given complete information regarding the research's objectives, methods, potential risks, potential benefits, and their rights. Finally, participants could ask questions and withdraw anytime without penalty.

2.8 | Confidentiality and Privacy

Participants' characteristics and responses were anonymized to protect their identity and avoid any risk of harm. Data was anonymized through the use of unique codes in place of names. Secondly, all data were stored in a secure location and findings were reported so that individuals cannot be identified.

2.9 | Beneficence and Non-maleficence

There was no potential risk to participants for this study. Rather, it sought to share essential information on how resilient health systems can be constructed.

3 | Findings

3.1 | Sociodemographic Characteristics of Respondents

A total of 1127 respondents participated in this study. Details of their sociodemographic characteristics are presented in Table 1.

Among the total respondents ($n = 1127$), 806 were females (71.5%) and 321 were males (28.5%). Within the nurse category, 60.1% ($n = 520$) were General Nurses. Public Health Nurses ($n = 180$) were the next largest group at 16% of respondents. Less common groups of nurses who were part of the study included Registered Midwives ($n = 86$, 7.6%), Ear Nose and Throat (ENT) Nurses ($n = 23$, 2.0%), and Eye nurses ($n = 12$, 1.1%). Moreover, nursing classifications such as Critical Care Nurses (CCN) and Nurse Assistant Clinical (NAC) occupied the lower parts of the distribution [0.7% ($n = 8$) and 0.4% ($n = 4$), respectively].

TABLE 1 | Sociodemographic characteristics of the respondents.

Variable	Category	Frequency	Percentage (%)
Sex	Female	806	71.5%
	Male	321	28.5%
Nurse category	CCN	8	0.7%
	Dental Nurse	9	0.8%
	ENT Nurse	23	2.0%
	Enrolled nurse	22	1.9%
	General Nurse	768	68.1%
	Nurse Assistant Clinical	4	0.4%
	Eye Nurse	12	1.1%
	Public Health Nurse	180	16.0%
	Registered Mental Nurse	15	1.3%
	Registered Midwife	86	7.6%
	Nursing qualification.	Certificate	97
Degree		578	51.3%
Diploma		315	28.0%
Masters		137	12.2%
Nursing rank	Deputy Director of Nursing Services (DDNS)	20	1.8%
	Enrolled Nurse (EN)	65	5.8%
	Nursing Officer (NO)	233	20.7%
	Principal Enrolled Nurse (PEN)	12	1.1%
	Principal Nursing Officer (PNO)	115	10.2%
	Senior Enrolled Nurse (SEN)	51	4.5%
	Staff Nurse (SN)	220	19.5%
	Senior Nursing Officer (SNO)	170	15.1%
	Senior Staff Nurse (SSN)	241	21.4%
Sector	Government sector	795	70.5%
	Private sector	153	13.6%
	Quasi Government Sector	179	15.9%

Source: Field Data, 2024

In terms of the nursing qualification of the respondents, 51.3% ($n = 578$) had a first degree and 28% ($n = 315$) had a diploma. At the same time, 12.2% ($n = 137$) of study participants had a Master's Degree. The survey was open to all nurses, and those who took part were all without a doctorate.

The highest number of nurses was SSN, 21.4% (241) by rank. The NOs were 20.7% ($n = 233$) while the Senior NOs were 15.1% ($n = 170$). Staff Nurses (SNs) accounted for the other ranks at 19.5% ($n = 22$). That being said, 70.5% ($n = 795$) of the respondents were from the Government (Govt.) sector and 15.9% ($n = 179$) worked in the Quasi-Government institutions and Private sector.

Majority of the respondents are 6–10 years (37.3%, $n = 420$) and 1–5 years (31.5%, $n = 355$) nurses. Moreover, 286 (25.4%) nurses had 11–15 years of experience, and 41 nurses (3.6%) had 16–20 years of experience. Just 24 (2.1%) of practitioners had been practicing for over 21 years.

3.2 | Level of Knowledge of Nurses on Disease X

Table 2 presents the individual questionnaire items that were used to measure the level of knowledge and how the nurses responded to these questions.

Table 3 shows the percentage of correct answers for each knowledge question based on the above responses. The study revealed that knowledge level of nurses is low regarding the Disease X concept. According to the questions for measuring the level of knowledge, the correct responses ranged from a mere 15.53% to almost half of the participants having correct responses (49.69%). This implies that knowledge gaps exist in some areas, indicating that many nurses may be unaware of the disease, mode of transmission, and implications.

As far as the awareness of Disease X as an emerging threat is concerned, only 21.92% ($n = 247$) of the participants correctly identified that Disease X is not an infection currently affecting

TABLE 2 | Questionnaire items on level of knowledge.

Questionnaire items	True	%	False	%
Disease X is an infection which is currently affecting people	593	52.6%	534	47.4%
Disease X is also known as Pathogen X	379	33.6%	748	66.4%
Disease X is likely to be of zoonotic etiology	289	25.6%	838	74.4%
Disease X has already affected millions of people	522	46.3%	605	53.7%
Disease X could emerge from already existing pathogens	560	49.7%	567	50.3%
Disease X is WHO's next prioritized disease for a pandemic	501	44.5%	626	55.5%
COVID-19 is likely to be more severe than Disease X	194	17.2%	933	82.8%
There are existing vaccines produced for Disease X	148	13.1%	979	86.9%
Disease X is caused by Pathogen X	383	34.0%	744	66.0%
Disease X is likely to be a laboratory-engineered disease	261	23.2%	866	76.8%
Disease X will only be transmitted from person to person	292	25.9%	835	74.1%

Source: Field Data, 2024

TABLE 3 | Level of knowledge of Disease X.

Question	No of correct	% of correct
Disease X is an infection which is currently affecting people	247	21.92%
The origin of Disease X is currently unknown	379	33.63%
Disease X is also known as Pathogen X	175	15.53%
Disease X is likely to be of zoonotic etiology	289	25.64%
Disease X has already affected millions of people	193	17.13%
Disease X could emerge from already existing pathogens	560	49.69%
Disease X is WHO's next prioritized disease for a pandemic	501	44.45%
COVID-19 is likely to be more severe than Disease X	313	27.77%
There are existing vaccines produced for Disease X	302	26.80%
Disease X is caused by Pathogen X	383	33.98%
Disease X is likely to be a laboratory-engineered disease	390	34.61%
Disease X will only be transmitted from person to person	195	17.30%

Source: Field Data, 2024

humans. Also, only 33.63% of the nurses ($n = 379$) were aware that the origin of Disease X is currently unknown. Regarding the etiology and transmission of Disease X, only 25.64% (289 nurses) were aware of the possible zoonotic origin of Disease X. This suggests that a correct understanding of how Disease X may spread sits only with a minority of respondents.

Additionally, the majority of respondents ($n = 558$) correctly indicated that Disease X could arise from pathogens that already circulated 44.4% ($n = 501$) and were aware that the next priority disease for a pandemic was a mysterious illness, Disease X. These values are at the high end among the other knowledge areas. That said, fewer than half of the sample were aware of these key features of Disease X.

Finally, a significant part of the respondents had misconceptions regarding Disease X with result showed that 34.61% of respondents ($n = 390$) believed Disease X could be a laboratory engineered disease, 33.98% ($n = 383$) opinioned that Disease X could be induced with Pathogen X, and 26.80% of nurses

($n = 302$) wrong understood that vaccine for Disease X had been successfully produced.

3.3 | Attitudes of Nurses Toward Disease X

Findings from the study revealed a broad spectrum of attitudes, indicating varying levels of concern, confidence, and preparedness among the nurses. Details of the nurses' attitudes toward Disease X are presented in Table 4.

A lot of nurses did not seem to trust what was being done for infection control at the moment. Only 16.5% ($n = 186$) agreed that these measures were effective and 33.5% ($n = 377$) disagreed. Meanwhile, skepticism regarding the current measures and their ability to prevent future outbreaks dominated the responses with 25.3% ($n = 285$) of respondents strongly disagreeing that the current measures would suffice to prevent transmission of the next Disease X. And on the bright side, 39.6% ($n = 446$) of them were optimistic that treatments or

TABLE 4 | Attitudes of Nurses toward the concept of Disease X.

Attitudes toward Disease X	Strongly agree		Agree		Neither agree nor disagree		Disagree		Strongly disagree	
		%		%		%		%		%
I am confident in the effectiveness of current infection control measures in preventing the transmission of Disease X	88	7.8%	186	16.5%	191	16.9%	377	33.5%	285	25.3%
I am concerned about the possibility of contracting Disease X from a patient who has it	56	5.0%	223	19.8%	219	19.4%	422	37.4%	207	18.4%
I am optimistic about the development of effective treatments or vaccines for Disease X in the near-future	99	8.8%	446	39.6%	230	20.4%	100	8.9%	252	22.4%
I am confident in my ability to use PPEs correctly to control the spread of Disease X	215	19.1%	420	37.3%	157	13.9%	44	3.9%	291	25.8%
I consider Disease X to be a major threat to my health as a nurse	113	10.0%	192	17.0%	488	43.3%	102	9.1%	232	20.6%
I am concerned I may not be able to care for patients who develop new types of diseases	48	4.3%	98	8.7%	451	40.0%	285	25.3%	245	21.7%
I consider Disease X to be a major threat to my patients	156	13.8%	176	15.6%	461	40.9%	129	11.4%	205	18.2%
I am confident in my ability to care for patients who develop any emerging infections	103	9.1%	248	22.0%	158	14.0%	425	37.7%	193	17.1%

Source: Field Data, 2024

vaccines will become available in the near-future. However, 22.4% ($n = 252$) strongly disagreed, demonstrating that some nurses were skeptical that effective treatment would be readily available soon. In addition, a significant proportion of nurses were also concerned about infection with the Disease X; in contrast to 14.6% ($n = 128$) who were not at all worried that a patient may transmit Disease X, 37.4% ($n = 422$) were worried about transmission by a patient; 19.8% ($n = 223$) were neutral with respect to this. In contrast, 18.4% ($n = 207$) of people strongly disagreed, indicating that they were not really concerned to contracting the disease.

Another area of exploration was confidence in the use of PPE (personal protective equipment). 37.3% ($n = 420$) reported confident that they would use PPE appropriately to mitigate the spread of Disease X while 25.8% ($n = 291$) strongly disagreed, illustrating a cohort of nurses that showed uncertainty regarding their PPE skillset. As to perceiving Disease X as an individual health threat, only 17.0% ($n = 192$) rated the risk of Disease X as high, and 43.3% ($n = 488$) remained neutral. And curiously, 20.6% ($n = 232$) strongly disagreed, indicating a large proportion of respondents didn't feel particularly threatened by the disease.

Finally, when respondents were asked if they felt prepared to care for patients with new and emerging diseases, 22.0% ($n = 248$) stated that they were confident in their abilities. On the other hand, 37.7% ($n = 425$) disagreed while 17.1% ($n = 193$) strongly disagreed, indicating the uncertainty among nurses on how to manage a patient with such a disease as Disease X.

3.4 | Practices of Nurses Toward Disease X

The findings shown in Table 5 revealed relatively low levels of practices in preparation and preventive measures toward Disease X.

Only 13.7% ($n = 154$) of respondents agreed when asked whether they were currently taking steps to prepare for Disease X, while a considerable proportion, 48.5% ($n = 547$), disagreed. Furthermore, 20.9% ($n = 235$) reported a strong disagreement, indicating that a good number of nurses do not feel ready for the potential spread of Disease X, while only 14.6% ($n = 164$) agreed that their healthcare facility had trained them how to manage the next Disease X. On the other hand, a total of 33.9% ($n = 382$) of nurses disagreed and a total of 39.5% ($n = 445$) strongly disagreed which denotes that the majority of nurses are not trained formally on how to handle the disease.

Approximately 42.1% ($n = 474$) agreed and 14.0% ($n = 158$) and 20.0% ($n = 225$), respectively, disagreed or strongly disagreed about IPC practices with all patients. This indicates that although many nurses do follow IPC measures, a considerable proportion may not consistently comply with these practices. In particular, since the fall of COVID-19, wearing a face mask has declined. Very few (17.6% ($n = 198$)) still wore masks regularly, whilst 35.8% ($n = 404$) and 21.3% ($n = 240$) disagreed and strongly disagreed, respectively, that mask-wearing is a common practice.

When asked if an emergency response plan exists in their facility, before answering positively (22.5%, $n = 254$) or negatively (strongly disagree: 22.2%; $n = 250$), 37.1% ($n = 418$)

answered 'don't know'. Additionally, there was a lack of clarity on preparedness mechanisms, with 22.7% ($n = 256$) agreeing that their facility had a surveillance system in place for Disease X while 19.5% ($n = 220$) disagreed.

Regarding participation in continued professional development activities, 69 44.2% ($n = 498$) of the participants agreed with the statement that they attend workshops to be updated on the emerging infections. However, 15.0% ($n = 169$) disagreed, and 16.9% ($n = 191$) strongly disagreed, suggesting that access to or engagement in CPD opportunities could be improved for some nurses.

3.5 | Determinants of the Level of Knowledge of Disease X

The fourth objective of this study was to explore the determinants of the level of knowledge nurses had about Disease X. To investigate this, a multiple linear regression analysis using the sociodemographic data collected at baseline was performed. Table 6 shows the results.

The overall regression model was statistically significant, with an F -value of 3.96 ($p < 0.001$). The model had an R-squared value of 0.0242, indicating that approximately 2.42% of the variation in nurses' level of knowledge about Disease X can be explained by the variables included in the model. While this is a relatively small portion of the variance, it highlights that other factors not included in the model may also be playing a role.

Findings revealed that the significant predictors of the level of knowledge among nurses on Disease X were the sector they work in (public, private, or quasi-government) and the number of years of practice. Nurses working in the public sector were significantly more knowledgeable about Disease X compared to those in the private sector. The sector variable had a coefficient estimate of 0.35049 ($p < 0.001$), meaning that working in the public sector positively influenced the level of knowledge among nurses. Further, the regression coefficient for years of practice was -0.12718 ($p = 0.005$), indicating a negative relationship. This suggests that nurses with fewer years of experience were actually more knowledgeable about Disease X compared to their more experienced counterparts. Nonsignificant predictors included in the model were nursing qualification ($p = 0.657$), nurse category ($p = 0.251$), age ($p = 0.103$), and sex ($p = 0.870$).

4 | Discussion of Results

The study revealed that the nurses' knowledge of Disease X was generally low, with correct responses ranging from 15.53% to 49.69%. Nurses had a better understanding of the potential for Disease X to emerge from existing pathogens, with almost half (49.69%) identifying this correctly. However, areas such as the zoonotic nature of Disease X and its transmission routes were less well understood, with only 25.64% recognizing the zoonotic potential. This knowledge gap is consistent with research on emerging infectious diseases in low-resource settings, where healthcare workers often face challenges in keeping up with rapidly evolving information due to limited access to continuous education and disease surveillance updates (Harries et al. 2020).

TABLE 5 | Practices of nurses toward the concept of Disease X.

Practices toward Disease X	Strongly agree		Agree		Neither agree nor disagree		Disagree		Strongly disagree	
		%		%		%		%		%
I am actively preparing toward Disease X	28	2.5%	154	13.7%	163	14.5%	547	48.5%	235	20.9%
My healthcare facility has trained us on the management of Disease X	24	2.1%	164	14.6%	112	9.9%	382	33.9%	445	39.5%
I implement infection prevention and control practices with all my patients	140	12.4%	474	42.1%	130	11.5%	158	14.0%	225	20.0%
I still wear my face masks even after the decline of COVID-19	138	12.2%	198	17.6%	147	13.0%	404	35.8%	240	21.3%
My facility has an emergency response plan	44	3.9%	254	22.5%	418	37.1%	161	14.3%	250	22.2%
I am familiar with the emergency response plan in my facility	64	5.7%	229	20.3%	412	36.6%	178	15.8%	244	21.7%
My facility has a surveillance system in place for Disease X	46	4.1%	256	22.7%	394	35.0%	220	19.5%	211	18.7%
I often attend CPD workshops to update myself on emerging infections	85	7.5%	498	44.2%	184	16.3%	169	15.0%	191	16.9%
I communicate unfamiliar signs and symptoms in my patients with the appropriate authorities	92	8.2%	497	44.1%	143	12.7%	150	13.3%	245	21.7%
I am actively engaged in public education and awareness toward Disease X	65	5.8%	205	18.2%	263	23.3%	375	33.3%	219	19.4%

Source: Field Data, 2024

TABLE 6 | Determinants of the level of knowledge.

Model fit measures							
Model	<i>R</i>	<i>R</i> ²	RMSE	Overall model test			
				<i>F</i>	<i>df</i> ₁	<i>df</i> ₂	<i>p</i>
1	0.155	0.0242	2.07	3.96	7	1119	< 0.001

Model coefficients – depth of knowledge about Disease X				
Predictor	Estimate	SE	<i>t</i>	<i>p</i>
Intercept	3.54561	0.3135	11.309	<.001
Sector	0.35049	0.0837	4.187	<.001
Nursing Rank	0.00398	0.0253	0.157	0.875
Nursing Qualification	0.03394	0.0765	0.444	0.657
Nurse Category	0.03820	0.0332	1.149	0.251
Age	0.01985	0.0122	1.632	0.103
Sex	−0.02277	0.1389	−0.164	0.870
How many years have you practiced as a nurse?	−0.12718	0.0453	−2.808	0.005

Source: Field Data, 2024

Similar trends were observed during the early stages of the COVID-19 pandemic, where healthcare workers worldwide struggled with understanding transmission pathways and the origins of the virus (Khan et al. 2020). It seems that the more familiar healthcare workers are with existing pathogens, the more confident they are in their knowledge, as seen here, but new or emerging diseases like Disease X introduce uncertainty (Kaye et al. 2020).

With regard to the nurses' attitudes toward Disease X, the results indicate mixed attitudes. Though 37.4% of them were worried about catching the illness from patients, a marginally greater number (39.6%) had hope for treatments or vaccines. But only half of the nurses were confident about the current infection control measures as 89.7% agreed that current arrest measures of infection were effective while 33.5% disagreed. Such findings sit in line with similar trends observed in previous pandemic studies where healthcare workers including physicians expressed initial skepticism about infection control practices, particularly if feeling they did not adequately prepare for or inform on protocols (Benjamin et al. 2018). For example, healthcare workers doubted the effectiveness of preventive measures framed in a certain way, until clear directives and specific forms of training were introduced as a response to the SARS and Ebola outbreaks (Pappa et al. 2020). The nurses' optimism about future vaccines and treatments reflects the trust healthcare professionals tend to place in medical advancements, a sentiment that has been noted in other studies on emerging diseases (Garrett 2020).

When it came to nurses' practices, the findings were somewhat concerning. Only 13.7% of the nurses were actively preparing for Disease X and 48.5% disagreed. Besides, 39.5% of the nurses mentioned responding their healthcare facility had not provided any training on how to manage Disease X, while 42.1% of the respondents stated that they always practice IPC measures to all patients. This lack of preparation and training is alarming, especially in light of how critical nurses are when health emergencies arise. Similar gaps were identified in studies undertaken in the early phase of the COVID-19 pandemic, with

healthcare systems unable to train their workforce fast enough to meet the required competencies (Adams and Walls 2020). The widespread implementation of IPC practices, despite the lack of Disease X-specific training, suggests that nurses rely heavily on the general infection control protocols learned during past outbreaks. This is consistent with research showing that generalized IPC measures are effective in preventing the spread of a wide range of infectious diseases (Siegel et al. 2019)

The regression analysis showed that two significant predictors of nurses' knowledge about Disease X were their workplace sector and their years of practice. Public Sector Nurses had higher knowledge than private sector Nurses (Coefficient = 0.35049; $p < 0.001$), while Years of Practice showed a negative relationship (Coefficient = −0.12718; $p = 0.005$). This means that the level of knowledge of Disease X increased for nurses with fewer years of practice, which may be due to being more recently trained. These findings corroborate studies which suggest that nurses employed in the public sector have a higher rate of access to structured training programs and resources compared to those in the private sector (Wilkins et al. 2021). The tendency for the newer cohort of nurses to score higher points is likely due to the most recent nurse education programs (tertiary educated) following updated content for the curriculum as well as the known inclusion of continuing professional development (CPD) opportunities for study of emerging infectious diseases. Such trends have been noted in studies investigating gaps in knowledge between more and less qualified healthcare personnel during previous health crises with those who were more recently trained more aware of protocols concerning new diseases (Greenberg et al. 2020).

5 | Summary, Conclusions, Recommendations and Suggestions for Future Research

The objective of this study was to examine the level of knowledge, attitudes, practices, and determinants of knowledge of

nurses about Disease X, a possible outbreak of a global health threat. A cross-sectional survey design was utilized wherein a total of 1127 nurses were recruited, with female nurses of the public sector predominating the respondents.

The knowledge levels were low, and nurses had better knowledge about the emergence of Disease X from pathogens already known. Many nurses were worried about catching Disease X and were less confident that existing infection control measures were effective. The findings for the practices demonstrated adherence to general infection control measures; however, the study highlighted insufficient preparedness and disease-specific training, especially in private healthcare facilities. Public Sector nurses and nurses with fewer years of practice were found to have greater knowledge of Disease X, according to multiple linear regression analysis.

Their results indicate that preliminary infection prevention measures are being implemented by a significant number of nurses, yet considerable gaps are evident in preparedness and disease-specific awareness of Disease X, especially among older nurses and nurses working in the private sector. The gap of specific training even for Disease X and the gray area of infection prevention in this study emphasize the urgent need for unique educational programs. Also, the low level of knowledge showed in the participants who had a higher years of experience in practice suggests that continuous professional development is vital in all healthcare workers whether they are new or experienced to the health system.

Based on the findings of this study, some key recommendations emerge. Firstly, healthcare facilities should implement regular, targeted training sessions focused on emerging infectious diseases like Disease X. These programs should be mandatory and updated regularly to reflect new information as it becomes available. Specific focus should be given to nurses in the private sector, where access to such training may be more limited. Also, special efforts should be made to ensure that senior nurses or those with more years of practice receive updated training on emerging diseases. This could be achieved through continuing professional development programs, which should be easily accessible and flexible to accommodate their schedules.

Further, there is an urgent need to better communicate information about public health threats within healthcare systems. Hospitals and clinics should establish a clear, streamlined communication process to ensure that all staff members are aware of new developments and the protocols that need to be followed. Finally, as a substantial proportion of nurses were not aware of the existence of any Disease X emergency response plan in their healthcare facilities' emergency response plans, comprehensive response plans proactively describing next steps for dealing with additional emerging diseases should be developed by healthcare facilities. This will hopefully instill confidence within staff and provide better preparation across the board. Finally, further study is required to understand the optimal methods of knowledge and preparedness enhancement among healthcare workers for emerging infectious diseases. Further studies can investigate the impact of various kinds of training programs or what barriers that nurses experience which hinders them from attending these programs.

Future studies should assess the impact of targeted training interventions on improving nurses' knowledge and readiness to

treat new diseases. And comparative research looking at how nurses in different healthcare systems (public vs. private, urban vs. rural) perceive and prepare for emerging diseases would yield even more granular insight about where gaps are, and how to address them. Lastly, to understand how knowledge and preparedness develop over time, future research should be up to date with longitudinal studies assessing the changes in nurses' knowledge, attitudes, and practices as new health threats arise and new training programs are implemented.

6 | Limitations of the Study

This study provides useful information on the knowledge, attitudes, and practices of nurses toward Disease X, but there are some limitations that must be considered. First, the study employed a cross-sectional survey design that is unable to provide information about the participants' knowledge and attitudes at multiple times during the study (e.g., before and after), which is more informative. That is, any knowledge or attitude changes in the nurses over time due to, e.g., updated information resources or training programs would not be reflected.

Second, self-reported data were used, which can be biased. Due to social desirability bias whereby participants provide answers they think will be more acceptable, they may have over or underestimated their knowledge or practices. Even though the survey was anonymous, this type of bias is still a frequent concern with research that uses self-reporting mechanisms. Finally, the sample was limited to nurses in Ghana, which may limit the generalizability of the results to other countries or regions with different healthcare systems or resources. As knowledge, attitudes, and practices could vary across different healthcare settings, socio-economic and cultural factors, and access to resources, the results may not be generalizable to other settings.

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