ORIGINAL ARTICLE

WILEY

Experiences and perceptions of final-year nursing students of using a chatbot in a simulated emergency situation: A qualitative study

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Abstract

Aim: The aim of this study is to explore the experiences and perceptions of final-year nursing students on the acceptability and feasibility of using a chatbot for clinical decision-making and patient safety.

Background: The effective and inclusive use of new technologies such as conversational agents or chatbots could support nurses in increasing evidence-based care and decreasing low-quality services.

Methods: A descriptive qualitative study was used through focus group interviews. The data analysis was conducted using a thematic analysis.

Results: This study included 114 participants. After our data analysis, two main themes emerged: (i) experiences in the use of a chatbot service for clinical decision-making and and (ii) integrating conversational agents into the organizational safety culture.

Conclusions: The findings of our study provide preliminary support for the acceptability and feasibility of adopting SafeBot, a chatbot for clinical decision-making and patient safety. Our results revealed substantial recommendations for refining navigation, layout and content, as well as useful insights to support its acceptance in real nursing practice.

Implications for Nursing Management: Leaders and managers may well see artificial intelligence-based conversational agents like SafeBot as a potential solution in modern nursing practice for effective problem-solving resolution, innovative staffing and nursing care delivery models at the bedside and criteria for measuring and ensure quality and patient safety.

KEYWORDS
artificial intelligence, chatbot, evidence-based practice, nursing, patient safety

1 | INTRODUCTION

Clinical patient safety aims to reduce any risk associated with care to a reasonable threshold (World Health Organization - WHO, 2009). While the race to ensure clinical patient safety began with the publication of 'To Err is Human' (Institute of Medicine, 2000), two decades later, it remains one of the most important critical dimensions of quality of care, as well as an international challenge for both health care organizations and educational institutions (Kirwan et al., 2019). In this context, the provision of safe and high-quality health care will be dependent on clinical judgements and decisions made by professionals at all levels of the health care system (Melin-Johansson et al., 2017). The clinical decision, by definition, is a complex, dynamic selection process with numerous variables to be considered, resulting from the critical reasoning process and derived from both the knowledge and experience of the professional (Farčić et al., 2020; Manetti, 2019), in which, depending on the decision taken, the expected results can either have a positive impact or seriously compromise the clinical safety of the patient (White et al., 2021).

Nurses are continually making decisions as part of the care process, each of which requires four separate stages: information collecting, analysis, decision-making and implementation (Akbar et al., 2021). Yet, the evidence indicates that there is still a gap in explicit training in problem-solving strategies and critical thinking, which frequently leads to an inadequate decision-making competence (Chen et al., 2021). Recent research with newly graduated nurses shows how insecurity in decision-making leads to the need for a second opinion in the first place, which generally responds to an informal source of information, possibly based on clinical nursing practice but not always on evidence (García-Martín et al., 2021). Clinical nursing practice and clinical simulation allow nursing students to acquire the skills required for professional practice while also supporting them in making independent clinical decisions and cultivating social problem-solving abilities (Ahmady & Shahbazi, 2020; Gandhi et al., 2021). In this context, the effective and inclusive use of new technologies could support nurses and nursing students in increasing evidence-based care and decreasing low-quality services (Braithwaite et al., 2020; Hospodková et al., 2021; Saini et al., 2017), including harmful care to patients, which is estimated to account for 10% of all iatrogenic harms or adverse effects of care worldwide (National Academies of Sciences, Engineering, and Medicine et al., 2018).

Over the last few decades, technological advances in voice recognition, natural language processing (NLP) and artificial intelligence (AI), as well as advances in components to support this type of technology, have increased the availability of dialogue systems for use in differing fields such as economics (Mai et al., 2019), business (Davenport et al., 2020) and health care (Schachner et al., 2020). Conversational agents are dialogue systems that use both AI and NLP, including a learning system based on statistical models that learn from data and make predictions based on a number of features (Kidwai & Rk, 2020). These agents can detect and interpret verbal and written language in order to engage with people via speech or writing in multiple formats such as web-based platforms, audio recordings or mobile apps (Milne-Ives et al., 2020). Chatbots are now available in different degrees of sophistication, ranging from more advanced models such as robots, holograms or avatars to simpler forms such as chatterboxes, in which the user can interact with an AI via written language or typing and maintain a conversation through an interface that generates conversation parameters and natural responses (Xu et al., 2021).

Notwithstanding most conversational agents in the health sector have been developed with the aim of incorporating patients in their health process (Jang et al., 2021), as well as targeting a population with limited access to the health system or with little information on health issues (Gardiner et al., 2020), little is known about their application in nursing clinical practice training and clinical simulation to promote efficient clinical decision-making and problem-solving abilities in patient safety. Thus, the aim of this study was to explore the experiences and perceptions of final-year nursing students on the acceptability and feasibility of using a chatbot for patient safety by incorporating the best evidence-based dataset into their clinical decision-making process.

2 | MATERIALS AND METHODS

2.1 | Design

A qualitative descriptive study was conducted using focus groups from September to November 2021 (Sandelowski, 2000). In this study, students used a task-based conversational agent to assess and manage an acute pesticide poisoning in a simulated rural primary care setting.

2.2 | Participants

The study was carried out at the University of Almeria. The selection criteria included final-year nursing students who (i) were enrolled in Research Methodology module, (ii) attended to more than 80% of lessons and (iii) whose participation was voluntary. Participants did not receive any previous chatbot training prior participating in this study. Furthermore, participants were advised that their experiences would not have any bearing on their academic grades. Sociodemographic characteristics are summarized in Table 1.

2.3 | Procedure

The chatbot, called 'SafeBot', was designed as a decision tree algorithm conversational agent to support nursing students in assessing and managing an acute pesticide poisoning in a simulated rural primary care setting. The preliminary content for the chatbot was developed by the authors based on the Reason's Swiss cheese model for patient safety (Seshia et al., 2018). This model combines the concepts underlying the Swiss cheese model (e.g., active involvement of

stakeholders, coordination and collaboration across organizations, promoting a safety culture and automating tasks) and cognitive biases plus cascade to better understand the complexities of reducing harm and provide an evidence-based strategy for proposing potential solutions for adverse events (Reason, 2000). In this manner, the chatbot content integrated evidence-based strategies and information for acute pesticide poisoning that used a framework theory to foster well-informed clinical decisions and reduce potential error-provoking factors such as unhealthy cultures or an inadequate knowledge-experience-skill set (Afshari et al., 2021) (Figure 1).

The prototype chatbot system was designed as a health care application webchat that could be accessed via mobile and desktop devices. The purpose of using this prototype in a single simulated scenario was to collect more detailed qualitative data that could be used to develop a more accurate conversational agent based on nursing needs and expectations. Each interaction began with a welcome message that explained the purpose and capabilities of the chatbot using two preselected input phrases tied to specific situations: 'Are you in a primary care setting?' or 'Are you in a hospital care setting?' Once participants selected one of these two paths, they could self-direct to different methods in assessing an acute pesticide poisoning patient. Overall, the performance of the task-based chatbot followed the architecture depicted in Figure 2.

TABLE 1 Demographic characteristics of participants

Characteristics	Number (*n*)	Percentage (%)
Age		
18–23	96	84.21
24–29	10	8.77
30–35	3	2.63
36–41	2	1.75
42 and above	3	2.63
Sex		
Female	91	79.82
Male	23	20.18
Previous experience with chatbots (e.g., goal-based shopping chatbots)		
Yes	26	22.81
No	88	77.19

2.4 | Data collection

Researchers developed and agreed on an interview protocol based on the reviewed literature to encourage participants to give in-depth answers about the topic (supporting information Table S1). The primary researcher approached each eligible participant and invited them to participate. Twelve focus groups (FGs), composed of 8 to 12 students each, were conducted at the University of Almeria in September 2021 by two researchers, one of whom was a qualitative methods expert and an observer who assisted and took field notes. These group interviews were digitally audio recorded and lasted between 40 to 60 min. Data collection was continuously analysed through an iterative process until data saturation was reached. Participants were given the option to revise the recorded transcripts and read their transcriptions before beginning the data analysis process to ensure that their views were accurate.

2.5 | Data analysis

Data analysis was based on thematic analysis and supported the ATLAS.ti v9.0 software (Braun & Clarke, 2006). First, recording interviews were transcribed by two researchers and familiarized themselves by reading all transcripts repeatedly and organizing relevant data into meaningful codes of the first two interviews in an inductive and exploratory approach. Codes were reviewed and altered to assimilate new data as coding continued, which were then classified into potential themes to reflect participants' experiences and perceptions. Following that, these themes were reviewed by reading all codes and the entire set of data to confirm thematic validity before defining and naming them and preparing a final report (Figure 3).

2.6 | Ethical considerations

This research was conducted out with the agreement of the Ethics Committee at the University of Almeria (EFM 159/2021) and in accordance with the Declaration of Helsinki's ethical principles. Confidentiality and anonymity were ensured by assigning alphanumeric IDs to each participant (letters 'G-X' [group] and 'P-X' [participant]). Prior to the study, participants provided informed consent and had the option to withdraw at any moment.
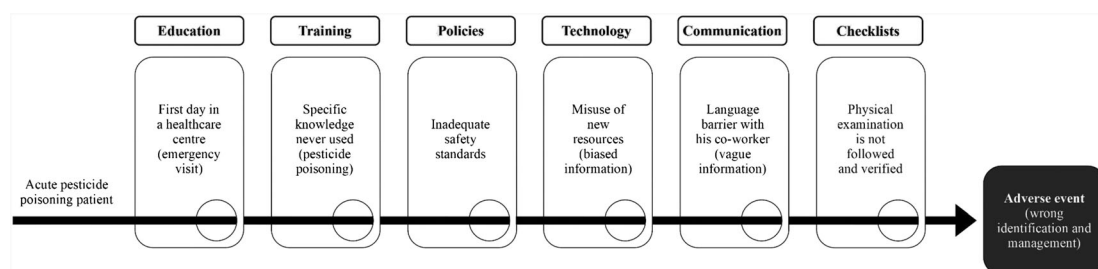

FIGURE 1 Each slice of Swiss cheese model as error-provoking factors in adverse events (acute pesticide poisoning)
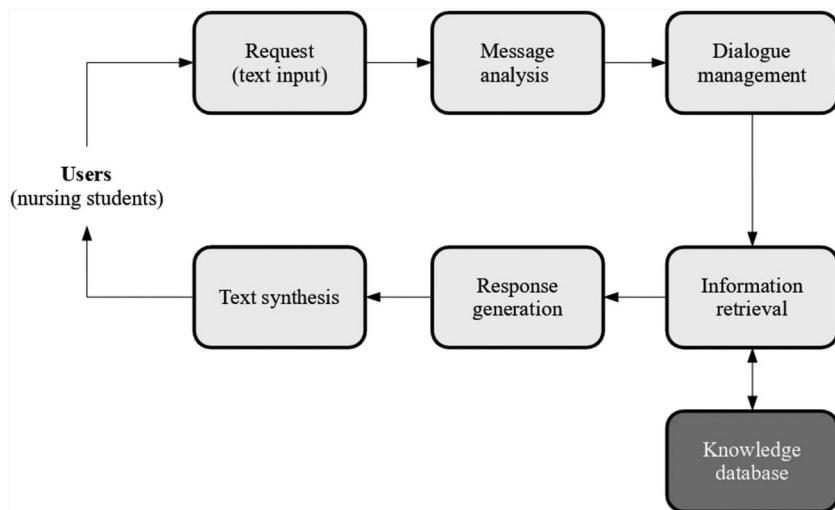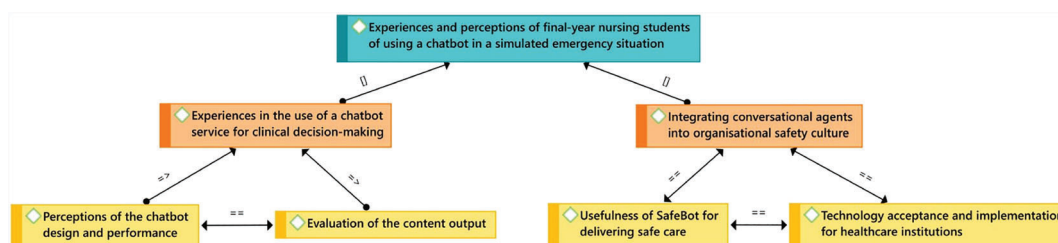
FIGURE 2 System architecture for the proposed chatbot

[]: is part of; ==: is associated with; =>: is cause of

FIGURE 3 Conceptual map based on fourth-year nursing students' experiences with using a chatbot for clinical decision-making and patient safety

2.7 | Rigour

Methods and findings are reported in line with the consolidated criteria for reporting qualitative (COREQ) research principles (Tong et al., 2007). The credibility, transferability, dependability and confirmability criteria developed by Lincoln and Guba (2006) were used to assess trustworthiness. Additionally, two researchers conducted thematic analysis independently to confirm its validity and accuracy. If their analyses differed, a third researcher was consulted to reach an agreement. All of the researchers agreed on the final results. The researchers participating in the chatbot design were not the same as those in charge of data collection. None of them were involved into the academic module assessment.

3 | RESULTS

3.1 | Participant characteristics

One hundred fourteen final-year nursing students participated in 12 FGs, representing a participation rate of 79.17% ($N = 144$ total final-year nursing students). The average age of the nursing students was 22.71 years old ($SD = 5.75$), with a range of 19 to 57 years.

Generally, 79.82% of individuals ($n = 91$) identified as female, whereas 20.18% identified as male ($n = 23$). Table 2 summarizes the findings of qualitative analysis, which identified two primary themes.

3.2 | Theme 1: Experiences in the use of a chatbot service for clinical decision-making

This first theme focuses on the participant's interaction with SafeBot during a simulated emergency situation. Participants expressed their perceptions on its design and performance, such as how this tool organized the information, how the flow was, its feasibility, as well as some visual appeal, among others. Moreover, the participants highlighted some characteristics of the chatbot content, such as its pace, precision or adequacy.

3.2.1 | Subtheme 1.1: Perceptions of the chatbot design and performance

The majority of participants indicated positive experiences with the chatbot during the simulated scenario, outlining its brevity, usefulness and user-friendliness. However, some participants emphasized some

TABLE 2 Themes, subthemes and representative quotes

Main themes	Subthemes	Representative quotes
Experiences in the use of a chatbot service for clinical decision-making	Perceptions of the chatbot design and performance	'*It was interesting that the chatbot only had text-based buttons because in a stressful situation, such as the simulated case, where you have to assess the patient quickly, you may not want to waste time typing or even being blocked if you have to talk with a machine instead of a person*' G12-P4
		'*I like the idea of a tool that can organise all of the information that is sometimes complex and maybe can be useful in care settings. Not just in emergency situations, but also in primary care and hospitalisation. The only thing that I missed was finding more options because you sometimes need identify other things that could be introduced by voice rather than just following the software roadmap*' G1-P7
	Evaluation of the content output	'*The chatbot information was precise and concise, as we were in an emergency situation and needed to act as soon as possible. Perhaps in other care settings, it would be a good idea to include more information or give us the option to click on links that provide us with more evidence-based information*' G8-P6
		'*The content that appeared on the screen when the final decision was made was quite informative. It was comprehensive and useful, but the screen before failed to provide us with enough information to clear our thoughts and determine whether we were on the right direction*' G10-P2
Integrating conversational agents into organizational safety culture	Technology acceptance and implementation for health care institutions	'*From my point of view, I believe that what many people may think about this chatbot is that it will eventually replace us. It is necessary to demonstrate that it is not intended for replace anyone, but to provide safer and high-quality care*' G9-P8
		'*I found it useful in the sense that it can be a resource we can use in our day-to-day work because of the amount of care that we offer and because of the rush, we sometimes need something that helps us to solve some question that we had at the time. Yet, I also see a need for a good design, for example, in the data treatment, how to collect the data, and so on, so I think this can make professionals think about what is being used and how their data is managed*' G5-P2
	Usefulness of SafeBot for delivering safe care	'*It makes me wonder how this chatbot can boost our confidence in our nursing practice. This type of technology supports you because you know it uses evidence-based information, and if you have any doubts, it is a quick and user-friendly tool*

(Continues)

TABLE 2 (Continued)

Main themes	Subthemes	Representative quotes
		to clarify any question that arise in any care setting' G4-P5
		'It will depend on the care setting in which the chatbot will be implemented because, for example, in an emergency unit the time to interact with the chatbot is so limited. It could be interesting develop other types of chatbots that allow for faster interaction, such as voice recognition, rather than text or text-based buttons, which may be more difficult to be used in that context' G3-P1

aspects for improvement, such as the accuracy of the information or the suitability of the colours used:

> 'I found the use of the chatbot in an emergency situation to be incredibly helpful and user-friendly, a real safe boat! On a management level, I think it was quite intuitive; it was simple to navigate between the options provided, it was quick, and it allowed us to make a faster and evidence-based decision. I believe that if we hadn't had this tool, we would have had more doubts and would have taken longer to assist the patient, whereas this chatbot can clear up many of the doubts that can arise in these kinds of cases' G5-P9

> 'It was very interesting! Yet, it drew my attention because I am colourblind and it might be interesting to consider colours when designing the layout of resources like this. Due to the contrast of the font and background colours on some screens where I had to interact with the chatbot, it was difficult to read and see the options available' G2-P3

3.2.2 | Subtheme 1.2: Evaluation of the content output

Although many participants mentioned the applicability of using SafeBot to improve patient safety and the quality of care provided in any health care unit, as well as to have thorough information about a specific issue, some of them stated that they missed having the possibility to further explore the information to confirm its appropriateness:

> 'The content was concise, it provided the necessary information to move forward in the pesticide poisoning patient care process, and, most importantly, it appears to be quite useful in the content organisation that we can have about a niche area, such as poisoning, for example. Maybe this type of tech can help us in getting straight to the point and identifying what we require' G12-P6

> "In terms of content, I thought it was too brief. I would have liked to find more information or, perhaps, any option where I could select 'find out more' to see if this is what I wanted to select or not. You can pick 'the patient is conscious or unconscious' in the first option, but moving forward, we find an option that asks 'What type of pesticide could the patient have been exposed to?' and perhaps it would have been useful to check exactly what each type of pesticide was" G8-P8

3.3 | Theme 2: Integrating conversational agents into organizational safety culture

This theme shines a light on the importance of the benefits of using chatbots like SafeBot for nurses and patients, which can lead to an improvement in the quality of care delivered and patient safety and also the relevance of the acceptance among nurses for its use.

3.3.1 | Subtheme 2.1: Technology acceptance and implementation for health care institutions

Based on their placement experiences, some students pointed out the significance of involving nurses at the bedside care in the development and implementation of the chatbot because, as they outlined, new implementations can be perceived by professionals as adding to their workload. Furthermore, they also indicated that these innovations are sometimes rejected due to professionals' fear of the unknown and a feeling of not being supported by their managers, as well as some concerns related to data security management and other privacy issues:

> 'To be honest, I believe that the professionals' acceptance of this resource might be influenced by their fear of the unknown rather than their age. In my placements, for example, I see that it could not be related to the professionals' age, but to their fear of change. I believe that if you do not imply professionals in the development of the chatbot, we will return to the same routine, the

imposition of new instruments, equipment, etc., that eventually, they consider a burden and a waste of time' G9-P1

'Mostly, it will depend on the support that professionals receive from managers, sisters and administrative because many things that they ask to be used are just being left in there and they think that the professional should learn to use it. It is necessary for these professionals to be trained on how to use these resources as they can help professionals in providing a safer care' G1-P4

3.3.2 | Subtheme 2.2: Usefulness of SafeBot for delivering safe care

A large number of participants found the chatbot handy for their professional work because of its availability and ability to resolve doubts at any time, as well as a sense of self-confidence as a future novel nurse where the chatbot can help them when facing complex situations and the security of finding evidence-based information. On the other hand, they stated that the chatbot can be improved by developing a chatbot with voice recognition to be able to interact faster than typing or selecting options:

'I believe that SafeBot can be useful in terms of clinical patient safety, not only in emergency situations like the one used in the simulation, but also in primary care and other hospitalisation units. I believe that these types of resources, in particular, help us to organise our knowledge and keep us up to date on the most recent evidence available' G9-P2

'This chatbot is convenient for nursing professionals for several reasons. First, because it's available 24/7, it can allow us to confirm some knowledge that we have some doubts about, such as which is the scientific evidence about the correct collocation of a nasogastric tube, or even the ability to get information in the moments that you need to get updated faster and without having to use a database, create your research strategy, etc. I believe it is a simple, quick, and useful resource' G7-P4

4 | DISCUSSION

This study was aimed to explore the experiences and perceptions of final-year nursing students on the acceptability and feasibility of using a chatbot for clinical decision-making and patient safety. After analysing our results from the FGs, it was found that almost all participants reported positive feedback in terms of usability and acceptability, inferring a qualitative improvement in clinical decision-making and problem-solving abilities for patient safety in a simulated

scenario. While the design and use of conversational agents for patient-chatbot interaction in niche areas such as mental health and long-term care have been widely discussed (Abd-Alrazaq et al., 2021; Fitzpatrick et al., 2017; Schachner et al., 2020), this study yields some interesting and relevant findings regarding the use of professional–chatbot interaction in order to provide precise, evidence-based and timely decisions in patient care and safety. Nursing knowledge-driven and management processes are certainly gaining traction in order to leverage the best information available to ensure the quality and safety of care provided (Braithwaite et al., 2020; Shahmoradi et al., 2017); however, to the best of our knowledge, this is the first study to explore the use of task-based AI to promote patient safety by incorporating the best evidence-based dataset into the clinical decision-making process.

Our findings, like those of other studies (Abd-Alrazaq et al., 2021; Dhinagaran et al., 2021), denoted that participants found the design and performance to be engaging and motivating but also improvable. Although most participant reported that the chatbot had a clean design and user-friendly navigation system, other impressions were more centred around the idea of usability and its current limitations. Suggestions included highlighting not only the most essential information or allowing users to select interface colours or colour schemes, particularly for visually impaired professionals, but also other extensions of use such as oral interaction with the conversational agent (Koman et al., 2020). Others, on the other hand, suggested that a button-based navigation system could be sufficient, if not preferred, over free-text or voice interaction, which would be especially relevant to broader accessibility and valuable for new professionals who may not know the specific information they require during their clinical decision-making process (Beilharz et al., 2021; Curran et al., 2019).

A number of studies are currently looking for new approaches to integrate chatbots and AI-based conversational agents to support health-related activities, albeit the quality of content still needs to be improved (Park et al., 2019; To et al., 2021). While the information was found to be adequate, accessible and useful, nearly all participants felt that the content output could be more concise, accurate and employ appropriate length responses and also include other options to motivate participants to explore other related content at their own pace (Stal et al., 2021). One possible explanation for this could be the need of different levels of chatbot personalization (intrinsic, extrinsic or a mix of both) in order to create user profiles or user models and support personalized and adaptative features (Fang et al., 2018; Kocaballi et al., 2019). Indeed, earlier research has shown that adaptive conversational approaches such as determining level of expertise or confirmation strategies can improve system performance, usability and efficacy in clinical decision-making, resulting in increased accuracy and patient safety (Abd-Alrazaq et al., 2021).

These technologies may support organizations, senior nurses and other health managers in reducing biassed judgement and decision-making at both the individual and group levels, which may have a negative impact on patient safety at all levels of the health system (Mannion & Thompson, 2014). Based on our findings, however, there are certain challenges to be considered when integrating

conversational agents in real nursing practice. Whereas there appears to be a positive mindset and self-efficacy toward adopting a chatbot, adequate resources, time, training and knowledge are required to support acceptance and long-term use among nursing students and professionals (Brandtzaeg & Følstad, 2018; Følstad et al., 2018). This technology may support nurses and nursing students in making informed decisions during the patient care by automating the data process; however, the final clinical decision should rely on their clinical judgement, considering current evidence and a view of appropriate clinical practice (Akbar et al., 2021; Araujo et al., 2020). It should be noted that there may be professional concerns and reservations about using chatbots, including fear or uncertainty for the unknown, ethical and privacy implications or the perception of additional workload (Mokmin & Ibrahim, 2021). For these reasons, recent research suggests that front-line professionals should be involved in the design and implementation of decision-making support systems, sharing their perspectives and verbalizing their perceptions and underlying nursing practice requirements, thereby promoting a better adoption of their use for care quality and patient safety (Fritz & Dermody, 2019). Despite these findings lend weight to the idea that the digital age and the speed with which information is transmitted are transforming communications and clinical practices, the research on the use of conversational agents in nursing practice for patient safety is still limited (Curran et al., 2019; Rouleau et al., 2017). This could be explained by the fact that the most current software available for implementing conversational agents is fee-based and thus not cost-effective to maintain in clinical practice (Barthelmäs et al., 2021). Surely, some participants mentioned the usefulness and beneficial effects that such advances may have in promoting evidence-based clinical decision-making at the bedside, regardless this technology is not currently present in their actual clinical placements (Martinez-Garcia et al., 2021). Emerging information and communication technologies, such as AI-based conversational agents, may not only contribute in better patient safety judgements and decisions but also introduce new avenues for higher organizational safety culture values (Akbar et al., 2021). The use of more transparent knowledge sharing among organizational members through use of reliable resources may improve clinical decision-making abilities of nurses and develop methods for using common knowledge at an organizational level to promote trust and organizational culture (Yoo et al., 2019).

Conversely, there are important limitations to consider when interpreting our results. Given the exploratory nature of our study, nursing students were chosen to avoid potential technological barriers using a homogeneous sample within an uncommon clinical situation. Nursing students were only expected to interact with the task-based chatbot using a specified individual case scenario, a pesticide poisoning patient in primary care settings. This study also lacks a concrete measure for evaluating the chatbot interaction. Although there are considerable inventories for evaluating evidence-informed decision-making competence in nursing practice and training interaction with chatbot (Belita et al., 2021; Mokmin & Ibrahim, 2021), no studies have been found to explore the use of a toolkit to assess nurses-chatbot

conversations pertaining patient safety. To the best of our knowledge, no study has yet focused on the design of a chatbot for student or professional–chatbot interaction in clinical decision-making and patient safety, which has limited our discussion. Rather than concluding this topic, however, our findings warrant further discussion. Future research should explore a gamut of clinical scenarios and may use our preliminary findings to provide a more sophisticated chatbot design. A future challenge for the chatbot should be to include professional nurses and account for their needs in the design for accuracy, as well as to include other advanced forms of chatbots such as AI-based conversational agents with deeper levels of extrinsic personalization.

5 | CONCLUSIONS

The findings of our study provide preliminary support for the acceptability and feasibility of adopting a chatbot for clinical decision-making regarding nursing care and patient safety in certain situations, although more research using diverse methodological approaches is required. Our results revealed not just an overall positive response to the design, performance and content output but also substantial recommendations for refining navigation, layout and content, as well as useful insights to support its acceptance in real nursing practice. SafeBot may constitute a down-to-earth resource to help cover gaps in service delivery in terms of patient safety and to support clinical decision-making with appealing and easily available evidence-based information.

5.1 | Implications for Nursing Management

The rapidly changing digital era states the importance and urgency of strategies to improve present and future care delivery, clinical decision-making and patient safety. The use of chatbots by nursing and health care professionals promotes the adoption of best available evidence in practice, which might be particularly helpful for newly graduated professionals and novice practitioners. Leaders and managers may well see AI-based conversational agents like SafeBot as a potential solution in modern nursing practice for effective problem-solving resolution, innovative staffing and nursing care delivery models at the bedside and criteria for measuring and ensure quality and patient safety. While more research on the development and testing of more sophisticated conversational AI is required, these findings will contribute in driving new methods in the future landscape of nursing practice and promoting organizational safety culture.

CONFLICT OF INTEREST
The authors have no conflict of interest to report.

ETHICS STATEMENT

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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