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Pharmacists' Knowledge, Attitudes, and Practices Regarding Nano-Pharmaceutical Availability in Hospitals

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Abstract

The medical application of nanomaterials with dimensions extending below 100 nm defines nanomedicine. The discipline provides solutions to multiple existing barriers in medical diagnosis and treatment management. Nano-pharmaceutical knowledge from pharmacists will increase drug availability in the market while enhancing patient compliance with medication protocols. The research aimed to determine whether nano-pharmaceutical medications existed in Sulaymaniyah hospitals while evaluating pharmacists' knowledge about these medications. This study applied a questionnaire with a cross-sectional design to determine the availability of nano-pharmaceutical medicines. It also examines the knowledge of these nano-pharmaceutical drugs among pharmacists based on questionnaires from previous studies on pharmaceutical formulations and nano-formulations. In addition, it tests the variables using Prism—GraphPad. The study collected one hundred surveys from pharmacists of many hospitals in Sulaymaniyah city in Iraq. According to the findings, twelve are available in hospitals, with different frequencies, with Rapamune being number one, with a 72% availability rate. Furthermore, the respondents indicated that they know more about pharmaceutical formulations than nano-formulations. There were not enough nano-pharmaceutical drugs in Sulaimaniyah hospitals because there are no diverse nano-pharmaceutical formulations. Nano-pharmaceuticals should be better understood by pharmacists by including nanomedicine courses in undergraduate pharmacy curricula.

Introduction

Nanotechnology has become one of the most significant scientific breakthroughs of the 21st century. It offers new ways to make pharmaceutical products work better, get to people faster, and be safer. Nanomedicine is the use of nanoscale materials in medicine to improve drug solubility, stability, pharmacokinetics, and therapeutic effectiveness (Malik & Muhammad, 2023). The substantial potential of nano-formulations like liposomes, polymeric nanoparticles, nanoemulsions, dendrimers, micelles, and nanocrystals to boost drug bioavailability and lower systemic toxicity solidifies nanomedicine as a crucial element of contemporary drug development (Attiah, Obaid, & Al-Salihi, 2023; Faisal & Obaid, 2025). These benefits promote targeted delivery, regulated drug release, and fewer side effects, especially for medications with historically poor solubility or stability profiles (Qin *et al*., 2024; Tahitu *et al*., 2025).

The surface-area-to-volume ratio of materials increases significantly as they approach nanoscale dimensions, resulting in distinct chemical and physical behaviors that are absent from bulk materials (Ahmed *et al*., 2025; Wei, Liao, Mahmood, Xu, & Zhou, 2017). These changes lead to new pharmacological potential, improved reactivity, and modified

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mechanical and electrical characteristics (Mohammed Jumaah, Mahmood, & Demerchi, 2025). The market for nanotechnology grew from an estimated $50 billion in 2006 to $2.6 trillion by 2014, which can be explained by these transformative qualities(Pokrajac *et al*., 2021). Together, these elements highlight the significance of nanomedicine from both a scientific and financial standpoint.

Drug delivery methods have undergone significant changes in pharmaceutical sciences (Wang *et al*., 2024). For instance, polymer-based nanoparticles can lower immunogenicity, prevent the degradation of active pharmaceutical ingredients, enhance biodistribution, overcome multidrug resistance, and allow passive targeting through the enhanced permeability and retention effect (Ramanan, Bandara, Thakuria, & Adassooriya, 2025). Additionally, nanoemulsions enhance the solubility of poorly water-soluble compounds and reduce toxic reactions, whereas liposomes offer biocompatibility and controlled release(Song *et al*., 2025). Additionally, nanocrystals present chances to enhance oral bioavailability and produce more consistent absorption profiles. Significantly, targeted nanoparticles functionalized with specific ligands, such as RNA sequences, have demonstrated the ability to bind to and treat cancer cells specifically while minimizing systemic toxicity (Xiao *et al*., 2022). These advancements show how crucial nanotechnology is to improving pharmaceutical and medical treatment options.

The growing importance of nanomedicine in advanced pharmaceutical formulation and its growing relevance in global healthcare justify its selection as the study's thematic focus. Pharmacists need to be knowledgeable about the mechanisms, clinical benefits, and handling requirements of the increasing number of nano-based medications on the market. The physicochemical characteristics, delivery behavior, safety concerns, and storage requirements of nanomedicine are very different from those of traditional drug formulations. Pharmacists, who are crucial in guaranteeing medication safety, patient counseling, and clinical decision making, must have a thorough understanding of these characteristics (Balan *et al*., 2025). However, in many developing regions, nanotechnology education remains limited within standard pharmacy curricula, and continuing professional development opportunities are insufficiently available (Al-Nemrawi, AbuAlSamen, & Alzoubi, 2020). The necessity to evaluate pharmacists' knowledge of nanotechnology-based medications and their preparedness to handle such formulations in hospital settings is justified by these significant gaps.

Due to its evolving healthcare system and persistent issues with pharmaceutical supply, regulation, and professional training, the Kurdistan Region of Iraq offers a significant context for this study (Mahmood, Hadi, & Maolood, 2021). The availability of nano-formulated medications remains uneven, despite the region's advancements through the growth of hospitals and educational establishments. Difficulties include disjointed supply chains, a lack of regulatory supervision, inconsistent medication quality, and a lack of specialized training for pharmacists. Additionally, pharmacists frequently do not have direct exposure to these therapies during their academic or professional development, and nano-based medications are not yet commonly used in the region's healthcare facilities (Mahmood *et al*., 2019; Zhang *et al*., 2024). Therefore, determining the degree of pharmacists' knowledge is crucial to filling in any gaps that could prevent the safe and efficient application of nanomedicine.

According to a review of the literature, formulation development, physicochemical characterization, or clinical efficacy have received more attention in global research on nanomedicine than the knowledge and preparedness of pharmacists who oversee these treatments (Benderski, Lammers, & Sofias, 2025). There is a dearth of information about how pharmacists in Iraq and the wider Middle East perceive, comprehend, and feel about handling nano-based medications. This lack of knowledge may impede the modernization of pharmaceutical practice, slow the adoption of cutting-edge technologies, and increase reluctance in clinical decision-making. Therefore, it is essential to understand the viewpoints of pharmacists in order to support educational reform, enhance professional

training, inform regulatory development, and direct healthcare institutions in the successful and safe integration of nanomedicine.

Thus, the purpose of this study is to assess pharmacists' perceptions, knowledge, and awareness of nanomedicine in hospitals in Iraq's Kurdistan Region. It aims to assess attitudes regarding the safety and therapeutic benefits of nano-formulated medications, identify obstacles that prevent their integration into clinical practice, and ascertain the current level of availability and use of these drugs. The findings are meant to bolster institutional preparedness, assist in the creation of focused training programs, and help make better clinical and policy decisions. Eventually, the results will provide significant insights into how the region's healthcare systems can better train their pharmaceutical staff for new therapeutic technologies and guarantee their safe and efficient use in patient care.

Methods

The questionnaire was designed according to internationally recognized standards for survey-based research in healthcare sciences. A group of three pharmacy professors and two clinical pharmacists reviewed the first draft to verify its relevance to the study goals and had valid content. A pilot test with 10 pharmacists was also applied to see how clear and useful the questionnaire was. After that, some small changes were made. The final tool meets three main parts: one for demographic information, one for knowledge-based questions, and one for checking drug availability.

The sample size of 100 pharmacists was determined to be appropriate due to considerations of feasibility, resource availability, and the goal of offering a representative overview of the pharmacies in Sulaimaniyah hospital. This sample size, while modest, is adequate for producing significant descriptive statistics and for identifying emerging trends. GraphPad Prism was used to analyze the data. Descriptive measures, such as frequency, percentage, and cross-tabulations, were used to compare the levels of knowledge between traditional formulations and nanopharmaceutical formulations.

The study applied a structured questionnaire in a cross-sectional design to assess the pharmacists' understanding of nanopharmaceutical drugs. The questionnaire was created by relevant studies from various fields of pharmaceutical formulations and nanoformulations. The study team was classified into smaller groups to conduct interviews in many pharmacies simultaneously, to ensure a wide coverage and data collection. The participants have made a significant contribution to the method and have made it easier to collect data extensively. In this study, 100 employed pharmacists working for 100 different community and hospital pharmacies in Sulaimaniyah were used. To avoid miscommunication and allow answering all questions during the process, pharmacists were subjected to direct in-person interviews at their places of employment.

For the improvement of comprehension and response accuracy, the language of the research tool was Kurdish and English. The questionnaire consists of three sections: demographic and professional data, including gender, years of experience, education, and pharmacy type. The second contained difficult questions—four on traditional pharmaceutical formulations and four on pharmaceutical nanoformulations to assess the pharmacists' understanding. The third tested the availability, dispensing measures, and use patterns of nanopharmaceutical drugs in local drug stores.

Results and Discussion

In this study, 100 pharmacists participated in the survey, each working at a different hospital pharmacy in Sulaymaniyah. Figure 1 shows the socio-demographic features of the respondents. Most had graduated from local universities or educational institutions, and 81% were men, a characteristic of the pharmacy workforce in the area. Also, (88%) held a bachelor's degree, while a small fraction had pursued postgraduate qualifications, suggesting that advanced academic training in pharmacy is still restricted. A more in-depth view of the results indicates that the gender imbalance, with 81% of participants being male, may be a sign of larger social and cultural factors that influence the healthcare workforce in the Kurdistan Region. The fact that 97%

of pharmacists work in private hospitals also suggests that the private sector is the main provider of pharmaceutical care. This could mean that training opportunities and access to resources are not as good in government institutions.

Furthermore, 76% of the pharmacists had worked in hospital pharmacies for 0 to 5 years. This means the pharmacy staff in Sulaymaniyah are young with their early professional development. Additionally, 97% of respondents worked in private hospital pharmacies, and 3% in governmental hospitals. This big discrepancy entails that private-sector pharmacies provide most of hospital-based pharmaceutical services in the city, and this staffing distribution could affect training opportunities, access to resources, and patient care delivery.

The knowledge section had eight questions. The questions evaluate the pharmacists' understanding of conventional pharmaceutical and nano-formulations. The questions were taken from past studies which Table 1 shows.

When analyzing Table 1 in more detail, it's clear that pharmacists did very well on questions about suppositories (96% accuracy). It shows that they are familiar with dosage forms

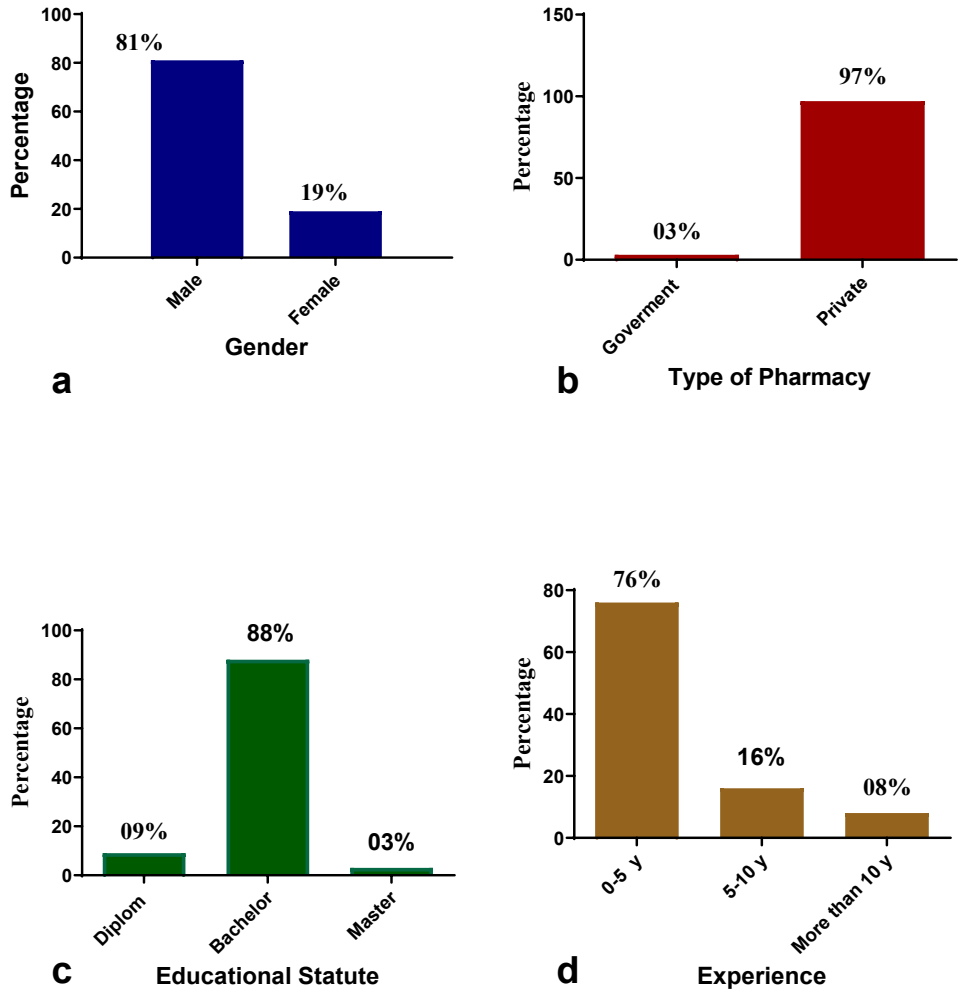

Figure 1. Sociodemography of the study participants: a. Gender; b. Type of Pharmacy; c. Educational Status; d. Years of Experience

Table 1. The Questions, Their Responses, and the Frequency

Nano pharmaceutical drugs	Choose the most characteristic feature of this pharmaceutical dosage form	Yes Frequency (%) N	No Frequency (%) N
Enteric-coated		90	08
	Decrease the doses and achieve slow/sustained releases of the drug.	07	
	Help the drug protect from stomach acid.	55	
	Used when vulnerable to vomiting.	04	
	I do not know.	24	
Liposomes		62	38
	Used when vulnerable to vomiting	21	
	Help the drug protection from stomach acid.	12	
	Decrease the side effects and enhance its pharmacokinetic profile.	24	
	I do not know.	05	
Sublingual		80	20
	Decrease the doses and achieve slow/sustained releases of the drug.	00	
	Prevent degradation or hydrolysis of the drug.	12	
	Fast drug absorption and protection from hepatic metabolism.	68	
	I do not know.	00	
Nanoemulsions		29	71
	Decrease the doses and achieve slow/sustained releases of the drug.	11	
	Help in protecting the drug from stomach acidity.	06	
	Used when vulnerable to vomiting.	01	
	I do not know.	11	
Corticosteroid Inhaler		75	25
	Deliver low water solubility drugs and help drugs' slow/ sustained releases.	07	
	The drug goes directly to the lungs, reducing the required dose and its side effects	63	
	Used when vulnerable to vomiting		
	I do not know.	05	
		00	
Polymer nanoparticles		38	62
	Protect the degradation or hydrolysis of the drug	09	
	The drug goes directly to the lungs, reducing the required dose and the side effects.	06	
	Used when vulnerable to vomiting.	07	
	I do not know.	16	
Suppositories		96	04
	a. Protect degradation or hydrolysis of the drug	27	
	b. Decrease the doses and achieve slow/sustained releases of the drug.	13	

	c.	Used when the patient is vulnerable to vomiting.	48	
	d.	I do not know.	08	
Nano crystal dispersion			32	68
	a.	Help in protecting the drug from stomach acidity	08	
	b.	Deliver low water solubility drugs and help in the drug's slow/sustained release.	06	
	c.	Used when vulnerable to vomiting.	02	
	d.	I do not know.	16	

(*) means the right answer

that have been used in the region for a long time. Nanocrystal dispersions had the worst performance, with only 6% accuracy. It shows that there is an urgent need for more education about newer and less familiar delivery systems. When compared to studies in other countries, pharmacists in Iraq are far behind those in Europe and North America, where specialized nanotechnology modules have already been added to the curriculum. It indicates the need to adjust the curriculum and keep learning in the area.

The findings from Table 1 also emphasize the imbalance between pharmacists' strong foundation in conventional formulations and their limited understanding of nanotechnology-based dosage forms. While almost all respondents correctly recognized the role of enteric-coated tablets and suppositories, the consistently low accuracy in identifying the functions of liposomes, polymeric nanoparticles, and nanocrystal dispersions reflects a significant educational gap. This divergence illustrates how the current pharmacy curriculum continues to prioritize traditional drug delivery systems while giving minimal coverage to emerging nanotechnology innovations. Without curriculum reform and targeted professional training, this disparity is likely to persist, limiting the ability of pharmacists to contribute effectively to the integration of nanomedicines into clinical practice.

The table shows the results of Figure

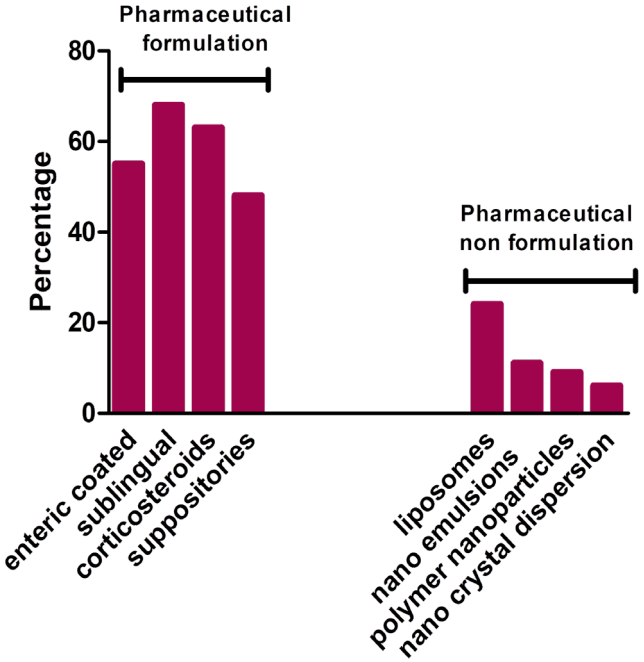

Figure 2. Knowledge of Pharmaceutical and Nano-Formulations Among the Pharmacists

2. Four of the questions were: enteric-coated tablets, sublingual formulations, corticosteroid inhalers, and suppositories. The remaining four were about formulations using nanotechnology, like liposomes, nano-emulsions, polymeric nanoparticles, and nanocrystal dispersions. The results showed that pharmacists knew a lot more about traditional pharmaceutical formulations than nanopharmaceutical formulations. In general, pharmacists were very familiar with traditional drug delivery systems and always got high accuracy rates. This pattern shows that traditional dosage forms have been covered in pharmacy schools for a long time and are still widely used in clinical practice.

Most participants were able to correctly identify the distinctive characteristics of each dosage form for traditional formulations. 90% of pharmacists correctly identified their role in preventing drugs from being broken down by stomach acid in the case of enteric-coated tablets. The ability of sublingual formulations to facilitate rapid absorption while avoiding hepatic first-pass metabolism was also well understood, with 80% of respondents correctly identifying this feature. Similar good results were shown by corticosteroid inhalers, which 75% of respondents acknowledged directly, deliver to the lungs, minimizing systemic side effects and requiring fewer doses. With 96% of pharmacists correctly choosing to use suppositories in patients who were at risk for vomiting, they produced the highest accuracy. When taken as a whole, these results demonstrate pharmacists' established understanding of the therapeutic explanation and practical uses of traditional dosage forms.

On the other hand, pharmacists were much less accurate when answering questions about formulations based on nanotechnology. The correct answer rates were only 24% for liposomes, 11% for nano-emulsions, 9% for polymeric nanoparticles, and only 6% for nanocrystal dispersions. These results show a big gap in pharmacists' knowledge, which means they don't know much about how nano-formulations work, their benefits in medicine, or how to use them in practice. The significant disparity between the two groups shows how hard it is for pharmacists to adapt to this new field in terms of education and experience.

Based on the FDA-approved nanopharmaceutical drugs, the registered nanopharmaceutical drugs in Kurdistan hospitals were developed (Figure 3). All twelve nanopharmaceutical drugs are found in the city under consideration. These include widely recognized formulations such as Doxil® (liposomal doxorubicin) for cancer treatment, Abraxane® (albumin-bound paclitaxel) for metastatic breast cancer, Onivyde® (liposomal irinotecan) for pancreatic cancer, and Rapamune® (sirolimus nanocrystal suspension) for immunosuppression, among others. According to the responses, nano drugs are often provided when needed by patients. Even though it was reported to be available, a thorough analysis indicated that the actual frequency of nanodrug accessibility is still low and inconsistent. There were differences in the levels of supplies between private and government hospital pharmacies, but these differences were not statistically significant. It means that registration guarantees official approval, but in the real world, access is limited by obstacles related to purchasing, stock shortages, and uneven distribution between institutions.

Further analysis of the responses showed that pharmacists with postgraduate degrees were better at recognizing nanotechnology-based formulations than those with only bachelor's degrees. The overall difference was not significant, indicating that postgraduate training in the region still does not place a strong emphasis on nanomedicine. In the same way, pharmacists with more than five years of experience were able to recognize traditional formulations slightly better, but they did almost as well as their less experienced coworkers on questions about nanoformulations. It shows a systemic gap in continuing education. Another important finding was that patients rarely come into contact with nanodrugs in regular pharmacy practice. Many pharmacists mentioned that even though nanomedicines were officially available in their hospitals, they were rarely prescribed because doctors usually chose traditional drug formulations, as they were more familiar with them and affordable. It indicates a disconnect between supply and demand, since registered nanodrugs are not

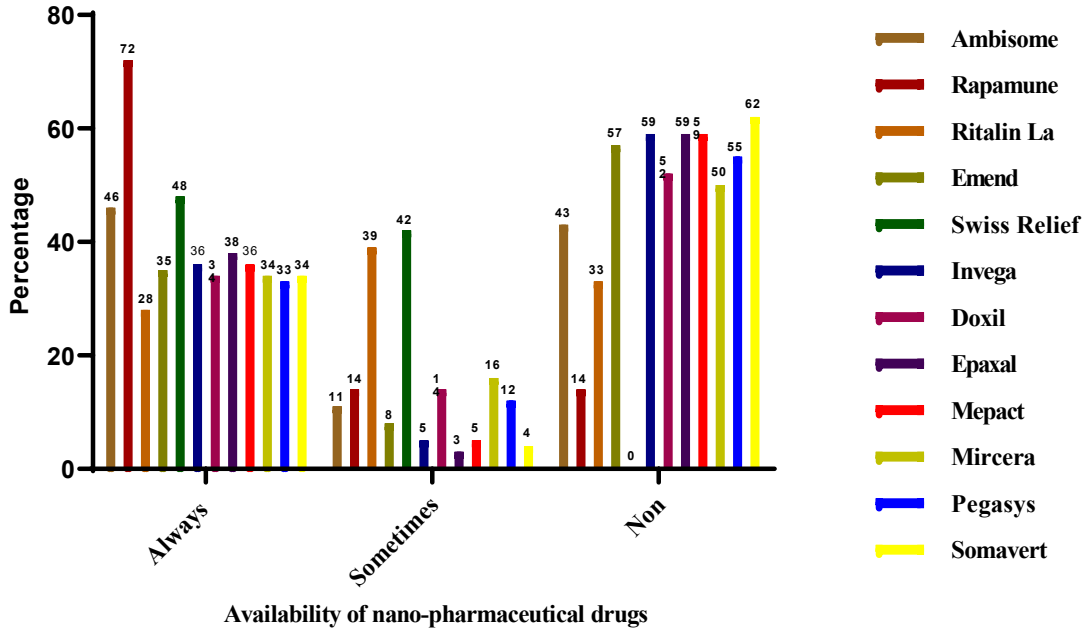

Figure 3. Availability of Nanopharmaceuticals drugs in Sulaimanyah Pharmacies

widely used in clinical settings.

When comparing the responses of pharmacists working in government hospitals to those working in private hospitals, it was interesting to note that there were no significant differences in their levels of knowledge. However, pharmacists at private hospitals said they had slightly better access to nanodrugs, probably because their procurement systems were more flexible. This trend shows that the way institutions are constructed can impact not only how convinience to get drugs, but also how often pharmacists can apply advanced therapies in their work. A correlation analysis between years of experience and knowledge of nanomedicines revealed a significant finding: pharmacists in their initial five years of practice exhibited knowledge gaps akin to those of their more experienced counterparts. It indicates that the problem is not solely associated with experience, but rather highlights inadequacies in both undergraduate education and postgraduate continuing education programs. These gaps are not likely to close over time unless there are significant changes to pharmacy education, no matter how long someone has been working in the field.

The survey also showed that pharmacists didn't have many opportunities to attend professional workshops or training programs specifically about nanomedicine. Within the last five years, fewer than 15% of those who took part said they had been to a seminar, conference, or training session about nanopharmaceuticals. This lack of opportunities for professional growth makes the knowledge gap even bigger and shows how important it is to have organized continuing education programs in the area.

Our results align with those of other studies in developing countries. For instance, studies conducted in India and Pakistan have shown that pharmacists possess substantial knowledge regarding conventional dosage forms but display considerable deficiencies in their understanding of nanotechnology-based medications. In the United States and several parts of Europe, on the other hand, pharmacists are learning more about nanomedicine through optional modules, workshops, and specialized postgraduate programs. This difference shows the slow development of nanotechnology in pharmaceutical education worldwide. Another important consideration is patient safety. If pharmacists don't have sufficient knowledge about nanodrugs, they may prescribe them incorrectly. It could make them less effective or cause unwanted side effects. Pharmacists are also crucial for counseling patients, which

is especially important for nanomedicines that may have special ways of being given or side effects. The knowledge gap identified in this study is not solely academic; it has a direct impact on patient care and treatment outcomes.

The situation is made worse by structural obstacles in Iraq and Kurdistan. Hospitals often say they don't have sufficient medicines they need, and nanopharmaceuticals are even harder to get because they are expensive and only work for certain people. The introduction of new technologies is slowed down by the fact that academia, industry, and healthcare institutions don't collaborate very much. To overcome these problems, we need to collaborate with various stakeholders, such as the government, schools, and medical companies. Germany and the UK have close ties between universities and businesses that have sped up the use of nanomedicines in clinical settings. We could learn from these countries. In addition to problems with education and supply, another important area is regulatory frameworks. The lack of clear rules for testing, registering, and monitoring nanopharmaceuticals in Iraq and Kurdistan is a problem. On the other hand, the FDA and EMA have made specific guidance documents about nanoparticle characterization, bioequivalence, and safety. Local regulators may face difficulty making sure both patient safety and the timely entry of new drugs into the market if they don't have similar rules.

Cost remains a significant obstacle. When compared to conventional formulations, the market price of nanopharmaceuticals is considerably higher due to the frequently used advanced manufacturing techniques. Accessibility is largely determined by affordability in areas where patients must pay out-of-pocket, and healthcare systems are underfunded. The extensive application of nanomedicines in Kurdistan will remain limited in the absence of government funding or insurance coverage. Pharmacists' knowledge gaps reflect larger gaps in the healthcare system. The lack of sufficient exposure to nanomedicine among doctors, nurses, and policymakers may also result in fragmented adoption. All healthcare disciplines must implement educational reforms as part of a coordinated, interdisciplinary strategy. This kind of integration would guarantee that nanomedicines are not only accessible but also properly understood, prescribed, dispensed, and monitored throughout the continuum of care.

Pharmaceutical nanotechnology is a recent and dynamic field within the pharmaceutical sciences. It focuses on the application of nanoscience and nanotechnology to develop new nanopharmaceutical medicines, improving drug delivery, therapeutic outcomes, and patient compliance. In the last decade, the number of nanopharmaceutical products used in clinical practice has rapidly grown. It shows how quickly science and technology are moving forward in this field. Even though nanopharmaceutical drugs are becoming more popular around the world, there is still a big gap in research on how much pharmacists know, how aware they are, and how they use them in their work, especially in developing areas. So, this study was done to find out how much pharmacists in Sulaimaniyah know about these drugs and how easy it is to get them in hospitals in Kurdistan.

Our results showed that pharmacists know much less about pharmaceutical nano-formulations than they do about traditional formulations. Most participants involved in the study were very familiar with traditional dosage forms, like enteric-coated tablets, sublingual formulations, and corticosteroid inhalers. However, their answers to questions about nano-formulations, such as liposomes, nanoemulsions, polymeric nanoparticles, and nanocrystal dispersions, were much less accurate. This variance is similar to other studies (Weissig, Elbayoumi, Fluhmann, & Barton, 2021). Based on our results, pharmacists are very good at developing traditional medicines but have only had limited experience with more advanced nanotechnology-based treatments, as shown in previous study (Assali et al., 2018). There are two main reasons for this gap: first, nanopharmaceutical development is a relatively new field of science, and second, most undergraduate pharmacy programs don't have any specific courses on pharmaceutical nanotechnology.

Pioneering efforts are being made worldwide to bridge this gap. Because

pharmacists play a crucial role in following and applying nanodrugs in clinical settings, pharmacy educators in the US support incorporating nanomedicine content into co-curricular electives, certificate programs, and student organizations(Barton & Borchard, 2022). European universities, especially in Germany, have also led the way in creating specialized master's programs and research tracks that focus on nanotechnology in drug delivery. These programs not only teach more about the theory, but they also give practical experience in synthesizing and testing nanocarriers (Huertas, Fuentes, Garcia, & Bustos, 2024). On the other hand, many developing countries, like Iraq and the Kurdistan Region, are still in the early stages of incorporating nanotechnology into pharmacy education. It means that practicing pharmacists don't have sufficient experience in this field, which is changing quickly.

The study also noted the advantages and disadvantages of its methodology. Its novelty is one of its main advantages, since it establishes a baseline for future regional and international comparisons and is among the first studies of pharmacists' understanding of nanopharmaceuticals in Sulaimaniyah. It is necessary to recognize a few limitations, though. The study was restricted to hospital pharmacists and excluded those working in community pharmacies, limiting the generalizability of the findings. Additionally, because responses rely on participants' understanding and willingness to participate, using self-administered questionnaires may have introduced reporting bias. Furthermore, the complexity of this developing field might not be adequately captured by the small number of questions used to evaluate knowledge.

To fill in the gaps found, targeted educational interventions are needed immediately. Adding specialized pharmaceutical nanotechnology modules to undergraduate programs, along with postgraduate training and professional workshops, would provide pharmacists with the skills they need. As a way to keep practicing pharmacists up to date on the latest news, continuous education programs and seminars are applicable. In addition to improving knowledge, it is just as important to handle the systemic obstacles, like the lack of nanopharmaceutical drugs and the general lack of important medicines, vaccines, and antidotes in hospitals in Kurdistan. By looking at how other countries do things, Kurdistan can establish partnerships between schools and businesses and put money into research centers for nanomedicine. It will ensure that pharmacists are ready and that new nanomedicines are available for patient care.

Several suggestions can be made based on our findings. First, pharmacy schools in Iraq should add nanomedicine modules to their undergraduate programs, along with hands-on lab work. Second, professional organizations should be conducting workshops and continuing education classes for pharmacists who are already working. Third, hospitals should enhance their purchasing systems and manage special groups to monitor the introduction of new therapeutic technologies. Finally, collaborative research centers that focus on nanomedicine could help minimize the gap between advances made around the world and how things are done in your area.

Conclusion

This study finds a significant difference between the knowledge of pharmacists in Sulaimaniyah hospitals regarding traditional pharmaceutical formulations and nanopharmaceutical medicines. Even though nanomedicines approved by the FDA are officially registered, they are not always available. Due to the procurement and supply systems. These results show the importance of including pharmaceutical nanotechnology in both undergraduate and continuing professional education. Also, the importance of well-built hospital supply chains and establishing partnerships between schools, hospitals, and businesses. Filling in these gaps will make pharmacists more prepared and ensure that patients in Kurdistan can benefit from new nanomedicine treatments.

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