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Nursing students' perspectives of the cause of medication errors

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SUMMARY

Background: Medication errors complicate up to half of inpatient stays and some have very serious consequences. To our knowledge, this is the first qualitative study of Iranian nursing students' perspectives of medication errors.
Objectives: To describe nursing students' perspectives of the causes of medication errors.
Design: Four focus groups were held with 24 nursing students from 4 different academic semesters in the nursing school in Tehran, between November 2011 and November 2012. Using a qualitative descriptive design, themes and subthemes were identified by content analysis.
Results: Two main themes emerged from the data: "under-developed caring skills in medication management" and "unfinished learning of safe medication management", which was subdivided into "drifting between being worried and being careful", and "contextualising pharmacology education". All respondents felt that their education programmes were leaving them vulnerable to "drug errors" and cited incidents where patient safety had been jeopardised.
Conclusion: Nursing curricula need to increase investment in medicines management. If nursing students are to become competent, skilful and safe practitioners, their learning will require extensive support from their academic institutions and clinical mentors.

Introduction

Medication errors are defined as any preventable event related to healthcare products, professional practice, and procedures including prescribing, order communication, compounding, dispensing, distribution, administration, education, and monitoring that may lead to patient harm (NCC MERP, 2005).

Avoiding medication errors is a vital component of patient safety (Kaushal et al., 2010). The true incidence of errors in preparation and administration of medicines is unknown: 54.4% of 983 US nurses surveyed indicated that not all drug errors were reported, due to fear of managers and peers (Mayo and Duncan, 2004). Estimates of errors of varying clinical importance, range from 24% to 94% of doses administered (Hoefel et al., 2008) and 52 (IQR 8–227) per 100 admissions (Lewis et al., 2009).

Nurse Education and Medication Errors

Nurses are the professionals closest to patients, and are the final link in the medication administration chain (Sulosaari et al., 2012). As the product of nurses' shared values and beliefs, medication safety can be taught, developed and internalised in undergraduate nursing programmes (Butterworth et al., 2011) to transform safety culture (Reid and Catchpole, 2011; Vaismoradi et al., 2011).

There is limited evidence that healthcare educators explicitly incorporate medication safety into professional education programmes (Attree et al., 2008). Thus, nursing students may receive relatively little education in error management techniques (Page and McKinney, 2007).

Much of the evidence emanates from developed countries, leaving the understanding of and solutions for unsafe medication for developing countries under-researched (Carpenter et al., 2010; Jha et al., 2010). Current literature on medication errors focuses on registered nurses, while nursing students' contribution to medication management remains unreported (Valdez et al., 2012).

Aims

The aim of this study was to describe nursing students' perspectives of medication errors.

Methods

Study Design

A qualitative descriptive design using a content analysis was used to generate information about the complexities of perspectives and

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behaviours. The value of qualitative description lies not only in the knowledge generated, but also as a vehicle for practice change (Sandelowski, 2010).

Settings and Participants

Focus groups were conducted with twenty-four nursing students from a nursing faculty in an urban area of Iran. Participants were chosen by purposeful sampling, to include 2nd (5 students), 3rd (14 students), and 4th (5 students) year students, to capture a range of perspectives (Coyne, 1997), based on length of theoretical and clinical learning experiences of causes of medication errors. Students with the highest grades in the research component of the course were invited to consider the study's aim and participate in focus groups on the basis that they would be best placed to critique the curriculum and analyse medication safety issues.

In the first year of the bachelor's degree nursing programme in Iran, students are taught basic nursing skills related to medication administration such as preparation, administration, and documentation in low fidelity skills' laboratories prior to clinical placements. Review of the institution's curriculum documentation shows no distinct, separate time allocated to patient safety and the safety principles of medication administration. Fifty one teaching contact hours are allocated to pharmacology in 4 years. Therefore, nursing students often graduate without meaningful or practical knowledge of patient safety (Vaismoradi et al., 2011).

Data Collection

Four focus groups, each with six students, were conducted. Focus groups capitalise on communication between research participants to generate data. This method is particularly useful for exploring knowledge and experiences and examining not only what people think, but also how and why they think that way (Webb and Kevern, 2001). Focus groups explore participants' experiences in an interactive format (Lambert and Loiselle, 2008). The heterogeneous composition of each group, in terms of academic semester, assisted exploration of diverse perspectives.

Focus groups, each lasting an hour, were held in Farsi. The first author, as moderator, explained the aim of the study, encouraged discussion, facilitated interactions among members, interjected probes, and summarised without interfering through note taking. A colleague managed the audio-tape recording, took notes, observed interpersonal interactions and encouraged quiet members to participate (McLafferty, 2004). The major explorative questions were:

- From your knowledge and experience in clinical practice, what are the causes of medication errors?
- How does your nurse education programme prepare students to administer and manage medication safely?

Probing follow up questions were asked to improve the richness of the data. Questions progressed from general to specific as topics were explored to generate detail and examples (Tong et al., 2007). Interviews were transcribed verbatim and iterative data collection and analysis proceeded concurrently. Once themes were identified and data saturation was achieved, no further focus groups were convened. Group dynamics were incorporated into the findings by presenting all nursing students' perspectives under each subtheme and theme (Webb and Kevern, 2001) (Appendix Table 1).

Ethical Considerations

The Research Council affiliated to Tehran University of Medical Sciences approved the research. The first author informed participants of the study's purposes and methods by oral invitation in the college in an open meeting. There was no coercion, and it was emphasised that participation was entirely voluntary and that students could refuse to participate or withdraw from the study at any time. Participants were reassured that their responses would be treated in confidence and their identities would not be revealed. Participants provided informed written consent.

Data Analysis

Transcripts were read through several times to obtain the sense of the whole, then subjected to content analysis (Hsieh and Shannon, 2005). Content analysis as a qualitative descriptive approach offered a practical approach for understanding perspectives with minimum artifice (Sandelowski, 2010). Drawing on Graneheim and Lundman (2004), data were analysed iteratively:

- The text was divided into words, sentences or paragraphs, related to each other through their content and context as units of meaning;
- Units of meaning were condensed, with core meanings preserved;
- Condensed units were abstracted and labelled with codes (an example of text coding is provided in Appendix Table 1);
- Codes were sorted into sub-themes based on comparisons of their similarities and differences;
- Finally, themes as the expression of the latent content of the text were identified for each focus group before convening the next group.

Rigour

Member checking was undertaken by two student participants from each focus group. Each focus group transcript and data analysis report were read, to ascertain whether the researcher was representing the students' perspectives. The authors reflected on the study's findings and reached a consensus. The plausibility of the findings confirmed that the analyses and interpretations were justifiable (Lincoln and Guba, 1985).

Results

All students approached agreed to participate, and no students were turned away. All respondents were female with mean age 22.3 years, standard deviation 1.3 years. Two main themes emerged during data analysis: “under-developed caring skills in medication management”, and “unfinished learning of safe medication management”. The latter comprised two subthemes: “drifting between being worried and being careful”, and “contextualising pharmacology education” (Fig. 1).

Under-developed Caring Skills in Medication Management

All students agreed that in their pharmacology and medical-surgical courses, lecturers provided theoretical information about medicines. The pathology and pharmacology of each disease were introduced, and the main drugs and their indications were named. However, the practical aspects of medication management and reasons for caution when administering the drugs were not discussed in detail or only briefly explained at the end of classroom sessions.

> *“Students mostly learn little about practical aspects of medication, and too long before their clinical placements.”* (S1Y4)

As taught, pharmacology was abstract, full of new names that were difficult to pronounce, and focused on theoretical pharmacodynamics and pharmacokinetics. Pharmacology was taught during the first year nursing programme, which was entirely college-based, therefore students needed refreshing and further practical education to be prepared for safe medication practice during their clinical placements in years 2 to 4 of the programme.

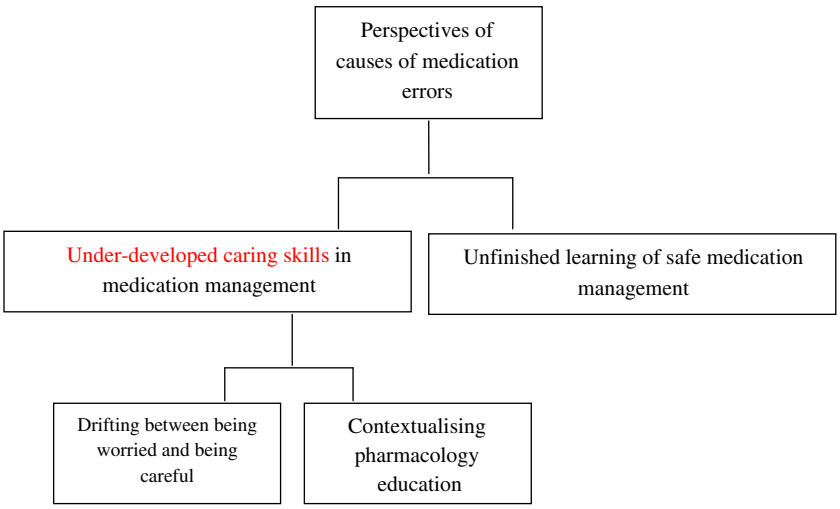

Fig. 1. An overview of themes and subthemes emerged during data analysis.

"The lecturer in the surgical ward asked me a question about a drug. I could hardly remember any information. Three semesters passed between the theoretical pharmacology course and starting on the ward." (S6Y3)

The students' practice focused on drug preparation and administration, and participants would have preferred more applied pharmacology to equip them to administer drugs safely.

"I have not got enough confidence to administer intravenous drugs or to check the doses of such drugs in practice, because I have not been taught this during my education." (S8Y3)*"I can explain how to prepare and administer intravenous drugs in theory, but I have not practised it yet."* (S4Y4)

Fourth year students said that core aspects of their education were missing. In addition to technical tasks, such as preparing and administering medication correctly, they needed to learn appropriate caring actions for patients receiving medication, including monitoring for adverse effects and long-term adverse drug reactions, teaching patients about their medicines and incorporating these practices into medication management.

All participants agreed that most medication errors and incidents emanated from the common perspective that nurses had fulfilled their caring duties once the drugs have been administered, and thus any adverse or long-term effects of medication were ignored.

"The nurse's job is not finished after administering the drug. It is continued until the patient is discharged safely." (S11Y3)

Medication management was envisaged as including caring actions, such as providing patients with jargon-free information about their drugs, including their indications and possible adverse effects.

"The patients wanted to know about the drugs that the nurses were administering, but the nurses were silent, and only mentioned the names of the drugs." (S4Y2)

Fourth year students added that updating patients about new medication orders, and educating patients on how to use the drugs at home were neglected aspects of caring and medication management.

"The patient had a long history of cardiac disease and knew all her drugs. She surprised the nurse by asking about a new drug she had just been given. I think the patient checked the accuracy of the nurse's medication administration." (S1Y4)

Development of caring actions in nursing students depended on both classroom learning and what they witnessed during clinical placements. In other words, lecturers' practical teaching and clinical nurses' behaviours in real nursing situations collectively developed student nurses' caring actions.

"The nurse lecturer should accompany the student during medication rounds and practically show him/her how to act and react in real nursing situations." (S2Y2)

Unfinished Learning of Safe Medication Management

All second and third year students agreed that they were not adequately prepared to administer and manage medications safely, due to shortfalls in their education. The students' lack of confidence also arose from their difficulties in reconciling their theoretical and practical learning. Their descriptions of why they felt their knowledge of drug safety was incomplete, is described in two subthemes.

Drifting Between Being Worried and Being Careful

During clinical placement, students were always warned against making any mistakes in medication administration. However, there were no strategies to develop their self-confidence or capacity to rely on their own abilities and knowledge gained from classroom teaching and clinical placements. Therefore, their learning experiences in clinical practice were characterised by worry over making mistakes. Fear of errors discouraged students from gaining sufficient experience in medication administration to become expert, self-confident or even fully competent, which set the scene for future mistakes.

"I do not like medication administration. I do not feel safe when I administer drugs. I am scared and check my movements frequently and even ask a lot of questions to be sure of my medication safety." (S13Y3)

The students resented the lack of independence in medication administration during their clinical placements, and the ensuing lack of self-esteem. They were not allowed to be fully involved in medication administration and management. In many cases, clinical staff only included students in risk-free aspects of medication management. Practitioners were anxious to minimise healthcare services' expenses, and clinical nurses were held responsible for the cost of medicines wasted due to nursing students' errors. Consequently, nurses were not inclined to involve students in medication-related activities.

"I was given an ampoule full of a white fluid, the name of the patient and her bed number, and of course a little instruction for intramuscular injection, but I wanted to do the job from its beginning. I mean the drug preparation." (S5Y2)

Fourth year students were worried that once their chance to learn medication administration had been lost during their second and third years, there would be no further opportunities, leaving them vulnerable to unsafe practice in their future careers.

"I liked helping the nurse with the preparation of the chemotherapy drugs, but she did not allow me to work with her, because it was said to be dangerous. So, how can I practise it to be competent, like a skilful nurse?" (S2Y4)

Contextualising Pharmacology Education

The students were concerned that resources and equipment described in their theoretical education were not available in practice. Pharmacology lectures were adapted from Western textbooks, accentuating the gap between the theory and its application to practice in Iran. Medication management education needed to be compatible with practice. For instance, computerised facilities for prevention of medication errors, advertised in textbooks, were unavailable in Iran.

"We are taught about ideal processes for medication management in theoretical courses in our textbooks. These are very different from our experiences in clinical placements." (S5Y3)

From fourth year students' perspectives, the staffing pattern in the Iranian healthcare settings was another barrier to safe medication administration.

"The nurse lecturer taught me to administer medication to one or two patients, at maximum. I am not prepared to work as a nurse who administers drugs to 10–15 patients at the same time." (S3Y4)

Students predicted that once employed, it would be impossible to apply the standard rules of medication management taught in the university. For instance, due to nursing shortages and problems of time management, nurses administered medication hastily and started medication administration too early. Students were aware that this could affect the drugs' plasma concentration, causing either sub-therapeutic or toxic concentrations, leading to either therapeutic failure or adverse effects.

"It endangers patient safety to administer medications too soon and hastily, but it is unavoidable because of nursing shortages." (S5Y4)

Also, the terminology used by clinical nurses differed from the scientific terminology taught in the classroom. Jargon, used verbally or in writing, could endanger patient safety, for example by incorrect drug substitution during medication administration.

"The nurse asked me: 'will you administer K to that patient?' I prepared potassium to be injected to the patient. In the middle of my way to the patient room, I became suspicious that perhaps the nurse meant vitamin K. I rechecked it with the nurse and she confirmed she meant vitamin K. I was lucky that I did not administer potassium to the patient who was suffering from heart disease." (S2Y4)

Discussion

All respondents felt that their education programme was leaving them vulnerable to "drug errors" and cited incidents where patient safety had been jeopardised.

Under-developed Caring Skills in Medication Management

Providing patients with information about medicines, monitoring and minimising or preventing medicines' adverse effects were key caring actions in this study. Nurses need knowledge and skills to minimise patients' suffering. Integration of humanistic caring perspectives into the teaching of pharmacology and medication management is required to meet patients' unique personal needs for safe administration, monitoring and management of medications (Eriksson, 2007). Concepts and knowledge related to caring should be integrated into nursing curricula to develop humanist thinking caring science, and models of care (Sherwood, 2011). For example, nurses should provide person-centred medication management, monitoring and information (Brataas et al., 2009), which contribute to patient safety (Wachter, 2010). Nevertheless, many healthcare professionals lack the knowledge, skills attitude to use nursing pharmacology theories in clinical practice (Sherwood, 2011), suggesting the need to modernise nursing education.

Development of caring actions to ensure medication safety required nurse lecturers and clinical nurses to act as role models (Reid-Searl et al., 2010), vital for promoting students' competence and confidence (Klunklin et al., 2011; Reid-Searl et al., 2010). Students' safe practice relied on the knowledge and skills of nurse mentors and role models at the bedside (Dickson and Flynn, 2012).

Unfinished Learning of Medication Management: Pharmacology in Nursing

Practical aspects of medication management were not broached in the classroom. Students felt they needed additional time in high-fidelity skills laboratories. In the international literature, the most prevalent cause of students' errors is performance deficits (Wolf et al., 2006), which relate to practical aspects of medication management, particularly administration (Gregory et al., 2009).

Incorporating experiential learning theories, such as the Kolb's, into nursing curricula promotes critical thinking. By creating an opportunity for students to reflect on experiences for example by case study teaching, this promotes acquisition of knowledge from experience (Jordan, 1997; Lisko and O'Dell, 2010). This recognises that nurse educators should ensure adequate theoretical knowledge of pharmacology and raise awareness of practical constraints and how these may contribute to medication errors (Page and McKinney, 2007; Bartley, 2011). While limited evidence exists regarding the extent to which the current content of undergraduate pharmacology education prepares nurses for their role in the prevention of errors (Page and McKinney, 2007; Brady et al., 2009), future work should explore whether the prescribed pre-licensure competencies are adequate and appropriate for new graduates' transition to practice (Sherwood, 2011).

Drifting Between Being Worried and Being Careful

Students' learning in clinical practice was characterised by worry and anxieties over mistakes. Students' self-confidence appears to be associated with competence in medication management (Sulosaari et al., 2012). The factors associated with medication competence are under-explored (Sulosaari et al., 2012), and little is known about mistakes made by nursing students and any associations with education programmes (Wolf et al., 2006).

Clinical nurses welcomed the students' partnership only in risk-free aspects of medication management and did not allow students to practise independently. To ensure success in training safe clinicians, students should be empowered to employ critical thinking skills in practice and develop the confidence necessary for safe professional practice (Papastrat and Wallace, 2003). A learning climate recognising

Table 1
Suggestions for improving the nursing curriculum based on themes and subthemes.

Themes	Subthemes	Suggestions for improving the nursing curriculum
Under-developed caring skills in medication management		To consider the interrelationship between theory and practice, teachers should spend time teaching and applying pharmacology, and include case studies as one component of teaching pharmacology. To learn the practical aspects of medication management, sufficient curriculum hours to teach and practice practical medication administration, monitoring and management should be determined. Revision sessions before clinical placements are required. Incorporation of opportunities to practise medication administration, management, and monitoring and patient teaching into clinical placements is advised. Sufficient curriculum time to teach communication of the medication process to the patient is needed. Designated role models for safe medication administration are needed in clinical areas.
Unfinished learning of safe medication management	Drifting between being worried and being careful	Students' self-confidence in medication management should be improved through teaching that mistakes are unavoidable and mistakes are learning opportunities. Students' worry and fear of medication process should be reduced by encouraging students to practice medication administration and take responsibility for this. Students should be involved and allowed to practice medication administration, management and monitoring and patient teaching independently with supervision.
	Contextualising pharmacology education	Theoretical education should be integrated with practice through teaching in simulation labs and in real healthcare settings. Nursing textbooks should be compatible with each culture and context.

the value of learning from errors and feedback details of medication errors and near misses to both students and lecturers was seen as important (Chang and Mark, 2011).

Contextualising Pharmacology Education

The association between nurses' poor working conditions and poor patient outcomes is hitherto unexplained, but these findings suggest that suboptimal staffing and equipment engender medication errors (Jordan, 2011). For instance, in the U.S. nurses may face occupational hazards and workplace stress, and sometimes agitated or uncooperative patients that may result in compromised patient safety (Bureau of Labor Statistics, 2011). These data indicate a relationship between staffing patterns, curriculum and practical resources and application of theory to real world practice and medication errors, congruent with suggestions that staffing, time pressure and workload negatively affect organisation of patient care (Anoosheh et al., 2008; Reid and Catchpole, 2011).

Differences in terminology used by clinicians and lecturers led to near misses, and could have resulted in serious errors. Poor understanding or unclear and inconsistent medication labelling is a root cause of medication error. Health literacy and language concordance are important in developing appropriate and safe medication management (Bailey et al., 2009).

Limitations

Patient safety is a sensitive research area, which might have discouraged participation and disclosure of errors; however, all those approached in this study volunteered for the focus groups. This study was conducted in one nursing faculty, the largest in Iran. Generalising findings from qualitative work and single site studies rests on logical or theoretical, rather than statistical, inferences (Mitchell, 1983).

Implications

Participants from a single geographical area, even if representative of that area, cannot be assumed to be representative of the target population as a whole. However, we feel that these findings illuminate some of the problems underlying the global issue of medication errors, and have sufficient practical adequacy (Sayer, 1992) to form the basis of curriculum development and revision. Accordingly, suggestions for improving the nursing curriculum, based on themes and subthemes developed in this study, are offered in Table 1.

Conclusion

To date, nursing research has focused on the extent of the 'medication error' problem, rather than its solutions. The importance of this study lies in presenting the perspectives, experiences and recommendations of nursing students on causes of medication errors. These findings resonate with experience in developed and developing countries. Nursing curricula should be modified to support students' learning and caring, to ensure that students become competent and skilful nurses, who administer, manage and monitor medication safely. Further work is needed to develop and evaluate nursing curricula uniting caring with safe medication management and monitoring.

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Conflict of interest

No conflict of interest has been declared by the authors.

Author contributions

MV was responsible for the study conception and design. MV performed the data collection and analysis. MV, SJ, HT, and TB were responsible for the drafting of the manuscript. SJ, HT, and TB made critical revisions to the paper for important intellectual content and approved the final draft to be submitted and published.

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Appendix A

An example of text coding of interviews four focus groups.

Coding	Extract from interviews
Lack of knowledge on drugs' practical administration	Focus group number 1 (Respondent S2Y3) I knew only what the name of the drug was and which diseases it would treat, but I knew nothing about how it should be administered in practice. Interviewer **How about you [other participants]? Do you think the same?** (S4Y3) Yes it is…. I believe the same. I got an excellent score in the final exam of the pharmacology course, but I know that my practical score is not excellent. Interviewer **What is the reason for this?** (S4Y3) I think it was the lecturer. Interviewer **Please elaborate it. What do you mean?** (S1Y2) She [the lecturer] did not teach us the practical aspect of medication… Interviewer **How was the medication process taught by nurse lecturers?**
Time gap between medication education and its practice	(S3Y3) … Drug information was presented in the first year of the nursing programme, and I forgot them all by the time I started the clinical placement. Interviewer **Will you please give an example on this?** (S1Y4) I was asked about the drug of…. The name was familiar to me, but I remembered nothing of it.
Education just before practice	Focus group number 2 Interviewer **What is your suggestion for reducing the negative impact of the time delay?** (S2Y4) … I think the education can be repeated before entering the practice. (3rd year student 6) Maybe it would be wise to begin the theoretical education right before entering practice.
Lack of confidence	Interviewer **Do you feel that you are able to practice medication safely?** (3rd year student 7) I have not got enough confidence to administer intravenous drugs or to check the doses of such drugs in practice, because I have not been taught in this regard during my education. (4th year student 3) Let me say that the medication process is not only about knowing drugs' names and their applications in practice….
Wider scope of nursing duties	Interviewer **An interesting point!** Interviewer **Please go on, what more should be taught to students?** (4th year student 2) I mean, the nurse's job is not finished just after administering the drug. It is continued until the patient is discharged safely. (3rd year student 7) I agree, nurses should take care about what happens after administrating the drug.
Providing information to the patient Reducing the patient fears	Interviewer **Can you give me an example, please?** (3rd year student 7) The patients wanted to know about the drugs that the nurses were administering, but the nurses were silent, and only mentioned the names of the drugs.
Updating the patient information	(3rd year student 8) The patients would not be so scared of the side effects of the infusions administered via the intravenous line, if they were told about the risks of side effects. (S3Y4) I have another example. For instance, nurses should always provide patients with information about changing drugs and so on.
Being accompanied with the lecturer	Focus group number 3 Interviewer **Do you think that theoretical education is enough for teaching all these information?**
Theory and practice incompatibility	(S2Y2) The nurse lecturer should accompany the student during medication rounds and practically show him/her how to act and react in real nursing situations. (S10Y3) What I witness in clinical practice on medication should be the same as what I am taught in the classroom. Sometimes I am confused when these two are so different.
Lack of knowledge application to practice	Interviewer **What do you mean by confused?** (S4Y4) In many cases, work condition hinders you to practice safely. Interviewer **Will you explain it more?** (S9Y3) I am not able to use my knowledge in practice, when the work condition is not suitable for safe medication…
Improving knowledge on risk-prone drugs	Focus group number 4 Interviewer **Was there any emphasis on the especial aspects of the medication process in nursing labs?** (S15Y3) We were asked to increase our knowledge on some especial drugs, which were mentioned to be the sources of practice errors by clinical nurses.
Focus on important drugs	Interviewer **Will you bring an example for it?** (S12Y3) We were repeatedly educated on how to prepare and administer Insulin. This was an important drug from the instructor's perspective, as far as I can remember. Interviewer **Is there any more example of such drugs?** (S5Y4) Nothing special….

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