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Accurate Peripheral Medication in Hospital – Preparation and Administration of Intravenous Therapy

Observation study

Helsinki Metropolia University of Applied Sciences

Bachelor of Health Care

Degree Programme in Nursing

Final Project

3.10.2014

Helsinki Metropolia University of Applied Sciences

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Title	Accurate Peripheral Medication in Hospital - Preparation and Administration of Intravenous Therapy. Observation study.
Number of Pages Date	27 pages + 3 appendices 3 October 2014
Degree	Bachelor of Health Care
Degree Programme	Degree Programme in Nursing
Specialisation option	Global and Transcultural Nursing and Health
Instructor(s)	Eila-Sisko Korhonen, Project Manager, Principal Lecturer Liisa Montin, Senior Lecturer

The purpose of this final project is to describe the existing practices in intravenous therapy in a hospital environment. Furthermore, the aim will be to generate knowledge on the intravenous therapy in a HUCHS hospital ward. The research question of this final project is how intravenous therapy is realized in practice. The project is part of the TOLA development collaboration project between Metropolia University of Applied Sciences and Hospital District of Helsinki and Uusimaa.

The method for data collection was quantitative, structured observation. Structured observation is a ''not concealed, no intervention'' method where the observers do not participate and remain passive in the background. The instrument was a chart developed by the TOLA project and has been translated by the students of the international programme under the supervision of the project manager. Total 40 hours were observed at the ward, 5 days were spread out for weekdays and for one weekend. N=19 completed preparation and administration were observed.

The results were analyzed and percentages in consistencies were calculated. Furthermore, the results had great deviation between the two observers due to challenges in environment and irregularities in the internal consistency in some items. The trends that were seen implicated good standards in personal hygiene, medicine storage, labelling and maintenance. However, the hand hygiene technique was seen as lacking and this seemed to be consistent in all of the staff despite of the fact that the use of disinfectant was relatively good. The duration of hand disinfection was almost always too short. Preparation and the administration of the medication were executed well. Patients were seldom identified prior to the administration which is explained by the close staff-patient contact. Cannula was checked every time, but it was uncertain if there was an appropriate assessment of the skin in the vicinity of the cannula.

In conclusion, the results describe the practice at the HUCHS hospital ward. The most lacking aspects were in the hand hygiene technique and its short duration. The observation study had many shortcomings, and the results should naturally be interpreted critically. However, it reflects quite accurately the current situation. Furthermore, it pinpoints to the need for awareness of the existing issues and that there is a clear demand for further education.

Keywords	accuracy, peripheral medication, intravenous therapy, preparation, administration

Tekijä(t) Otsikko Sivumäärä Aika	Atte Määttä Kerttu Spännäri Accurate Peripheral Medication in Hospital - Preparation and Administration of Intravenous Therapy. Observation study. 27 sivua + 3 liitettä 3 lokakuu 2014
Tutkinto	Sairaanhoitaja AMK
Koulutusohjelma	Hoitotyön koulutusohjelma
Suuntautumisvaihtoehto	Hoitotyö
Ohjaaja(t)	Eila-Sisko Korhonen, yliopettaja, projektipäällikkö Liisa Montin, yliopettaja

Tämän opinnäytetyön tarkoituksena on kuvata olemassa olevia käytänteitä suonensisäisessä lääkkeenannossa sairaalaympäristössä. Tavoite on tuottaa tietoa suonensisäisestä lääkkeenannosta HYKS:n sairaalan osastolla. Tämän opinnäytetyön tutkimuskysymys on kuinka suonensisäinen lääkkeenanto toteutuu käytännössä. Opinnäytetyö on osa TOLA-kehittämishanketta, joka on toteutettu yhteistyössä Metropolia Ammattikorkeakoulun ja HYKS:n medisiinisen tulosyksikön yhteistyöosaston kanssa.

Tutkimusmenetelmä on kvantitatiivisessa tutkimuksessa käytetty strukturoitu havainnointia, jossa havainnoijat pyrkivät vain havainnoimaan, mutta ei osallistumaan. Instrumenttina on käytetty havainnointilomaketta, jonka TOLA-hanke on kehittänyt aikaisemmin, ja sen ovat kääntäneet suomesta englanniksi kansainvälisen koulutusohjelman opiskelijat projektipäällikön valvomana. Yhteistyöosastolla on havainnointiin käytetty yhteensä 40 tuntia, viitenä eri päivänä arkipäivisin sekä viikonloppuna. Yhteensä kokonaisia havainnointiprosesseja tuli N=19.

Tulokset analysointiin ja yhteneväisyysprosentit laskettiin. Tuloksissa oli suurta hajontaa kahden havainnoitsijan välillä haasteellisen ympäristön sekä tulkintaeroista tiettyjen kysymysten kohdalla. Yleisesti positiivinen suuntaus näkyi henkilökohtaisessa hygieniassa, lääkkeen säilytyksessä, etiketöinti ja ylläpito. Toisaalta, käsihygieniatekniikassa oli selkeästi puutteita. Tämä näkyi kauttaaltaan henkilökunnan toiminnassa, vaikka käsihuuhdetta käytettiin paljon. Käsidesinfiointi oli ajallisesti riittämätöntä. Lääkkeen valmistelu ja anto toteutettiin hyvin. Potilastunnistusta ei ilmennyt juurikaan ennen lääkkeenantoa, mutta tämä voidaan selittää omahoitajamallilla. Kanyylin toimivuus varmistettiin jokaisella kerralla, mutta tilanteessa jäi epäselväksi, mikäli kanyylin kiinnityskohdan ihoa arvioitiin kunnolla.

Lopputulokset kuvastavat käytäntöä HYKS:n yhteistyöosastolla. Suurimmat puutteet esiintyivät käsihygieniatekniikassa sekä sen lyhytkestoisuudessa. Havainnointitutkimuksessa oli monia puutteita ja tuloksia tulisikin siten tulkita kriittisesti. Tulokset kuitenkin kuvastavat suhteellisen tarkasti olemassa olevaa käytäntöä. Sen lisäksi se osoittaa tarvetta tiedostaa ongelmakohdat, ja että lisäkoulutusta olisi tarpeen lisätä.

Avainsanat	accuracy, peripheral medication, intravenous therapy, preparation, administration

Contents

1 Introduction

Intravenous therapy (IV) is one of the most common methods of medicating in hospital wards. Intravenous route is efficient when the effect is needed immediately, to remove the first pass effect of the gastrointestinal system and to maintain the bioavailability of the drug at stable level. However, it is not without risks and could be considered as one of the most dangerous routes due to immediate effect as it enters the bloodstream and for the method being irreversible. Should complications arise, not only would it endanger patient safety, but it would increase the costs in the health care, as the unnecessary complications can lead to prolonged stay and to the use of expensive treatments such as wound care products and medications. (WHO; Carson, Dychter, Gold & Haller 2012: 84-91.)

Health care professionals are solely responsible for the medication of the patients in the hospitals. Thus they are expected to be educated about the correct preparation and administration of medications of different kinds. The correct steps are described in the literature extensively and expert guidelines are available for professionals. (Pratt 2007; HUS 2013.) However, the infections still occur in great numbers. In United Kingdom alone, 6000 patients suffer from a catheter-related infection every year (Lavery 2007).

The purpose of this final project is to describe the existing practices of intravenous therapy in a hospital environment. It is part of a bigger project TOLA, which is carried out in collaboration between Metropolia University of Applied Sciences and the department of the medicine of Helsinki University Hospitals (HUCHS). TOLA is a development project with an interventional goal. TOLA stands for Toimintamalli Laskimonsisäisestä Lääkkeenannon Oikeellisuudesta which is unofficially translated as A Model For The Administration Of Intravenous Therapy And Accuracy. It stemmed from a prevalence study conducted by the European Centre for Disease and Control (ECDC) to survey the numbers of infections occurring in health care settings within the European Union.

In this final project, structured observation is used and the specifically developed observation chart by TOLA project to describe the practice. Furthermore, the final project should generate knowledge about the intravenous therapy practice in an individual HUCHS hospital ward. The research question of this final project was chosen as to how intravenous therapy is realized in the field. Preliminary data search was conducted in order to gain an understanding about the phenomenon as a whole.

2 Background

2.1 Ten rights of medication

According to Aschenbrenner and Venable (2009: 33-34), intravenous therapy is the most invasive delivery of medication, as the medicine is administered directly to the blood circulation, thus the effects of medication take place almost immediately and the process is practically irreversible. Malach et al. (2006) found in eight years prevalence studies that 40% of the hospitalized patient had had intravenous therapy. Berman and Snyder (2012: 864) underline that safe medicine management consists of ten essential rules which serve as the basis for accurate and appropriate medication.

Table 1: Ten rights of medication (adapted from Smeltzer et al. (2010)

Right medication	Right client education
Right dose	Right documentation
Right time	Right to refuse
Right route	Right assessment
Right client	Right evaluation

If the ten rights are not adhered, it will be classified as a medication error, which is defined as a preventable occurrence conducted by a health care professional, which may cause harm to the patient (National Coordinating Council for Medication Error Reporting and Prevention 2013). However, this project does not concentrate on the mistakes but rather describe the practice. Moreover, the literature emphasizes the use of check lists (e.g. the Ten Rights) to assure safe medicine management (Berman & Snyder 2012: 864; Hicks & Becker 2006).

2.2 Personal hygiene

Generally, the maintenance of personal hygiene and appearance is mentioned in the hospital policies in order to create an impression of a professional. In the textbooks, it is recommended to keep nails short to lower the risk of scratching a patient or breaking gloves. The risks of artificial nails and polished nails can provide a platform for micro-organisms in comparison to normal nails. (Berman & Snyder 2012: 688.) Moreover, Rubb

et al. (2007) found out that the length of the nails correlates positively with the colonization of the micro-organisms. Wristwatches and other jewelries should be removed for the same reason as the aforementioned items (Pratt et al. 2007; Berman & Snyder 2012: 988). According to the study conducted by Rubb et al. (2007) one ring in the main hand increased the microbial colonization on the surface of the skin and the ring.

The skin of the hands should be intact and the staff should pay attention to open hangnails, cuts and abrasions (Berman & Snyder 2012: 688; Pratt et al. 2007). In case of visible cuts or abrasions, waterproof dressing is to be used such as a plaster (Pratt et al. 2007; Loveday et al. 2014). Uniform and arms must be bare below the elbows when in clinical patient work (Royal College of Nursing 2013; Loveday et al. 2014). Perry, Marshall and Jones (2001) found out in their study that uniforms facilitate the transmission of the micro-organism, thus elevating risk of contamination in staff-patient contact. In order to maintain personal hygiene Royal College of Nursing (2013) states that hair must be tied up so that it will not be handled during the nursing interventions.

2.3 Aseptic technique

Health care-associated infections (HCAI) are one of the major concerns and they are closely associated with poor hand hygiene. The World Health Organization (WHO) has aimed since 2004 to create comprehensive evidence-based guidelines about hand hygiene for health care professionals. The idea of the WHO guidelines is to decrease the transmission of micro-organisms and pathogens. (WHO 2009: 5, 12.) WHO has estimated that health care-associated infections are a worldwide problem and over 1.4 million are affected by it at any time (WHO 2005: 3). Furthermore, it has been estimated that between 5 to 15% of hospitalized patients have HCAI. This in turn is correlated with prolonged hospital stay, which means 25 million extra days in the hospital (WHO 2009: 6) Exact data is difficult to acquire but WHO (2005: 4) states that the most common nosocomial infections are urinary tract infections, lung infections, surgical site infections and blood infections.

Patient safety in intravenous drug therapy may be increased when nursing staff is educated about the transmission mechanism of pathogenic micro-organisms and the importance of hand hygiene. WHO (2009: 12) states that the transmission of micro-organisms on one hand happens through hand-to-hand contact between the patient and the staff or vice versa. On the other hand, vehicle-borne transmissions happen through contaminated environment by touching the surface by hands (WHO 2009: 12). According to Center of Disease Control (CDC 2002: 4) the pathogen transmission has four stages. In the first stage, health care worker has acquired pathogenic micro-organisms on the

hand. In the second stage, the pathogenic microbes need to survive on the skin surface long enough to be transmitted. In the third stage, the hand hygiene needs to be inadequate. In the fourth stage, the nurse needs to be in skin-to-skin contact with a patient. (CDC 2002: 4.)

WHO emphasizes in their guidelines the crucial steps for maintaining the appropriate hand hygiene. It should be performed before and after a patient-contact. Furthermore, it should be done before and after a procedure which itself requires a clean or aseptic technique. Moreover, it is important in case of being exposed to, but not limited to, bodily fluids like saliva, feces, urine or blood. Should be also performed before and after touching the patients' surroundings. (WHO 2009: 123.)

The correct method of hand washing and hand sanitizer is known to be effective against health care-associated infections. Therefore, WHO's (2009: 155) proposal for standard recommendations for a hand sanitizer with alcohol-based formula is an eight-step technique. The steps are performed sequentially starting from applying adequate amount of hand sanitizer according to the hospital policy. In the beginning, rubbing hand in the palm and repeat the step for the other hand. This is followed by rubbing the interlaced fingers on the back of the hand again and repeat the step for the other hand. Next step is to rub the palm against the other with fingers interlaced. Furthermore, rub fingers locked on the opposing palm. Next, both thumbs are rubbed separately. Then the fingertips are rubbed against the palm of the other hand and vice versa. At the end, hands are rubbed until they are dry and there is no residue left. The procedure should take generally 20-30 seconds. (WHO 2009: 155.) Albeit Kampf and Hollinworth (2008) found that 85% disinfectant was the most efficient one in the comparison group when it was used for shorter duration. HUS (2013) guideline states that alcohol concentration in the disinfectant should not be lower than 70%. Hand washing technique with soap and water is estimated to take from 40 seconds to 60 seconds until hands are dry and clean. Correctly done washing consists of eleven steps altogether. Hand wash is suggested when hands are soiled or visibly dirty and it should be done before using the hand sanitizer. (WHO 2009: 156.) However, this project only observes the occurrence of the hand wash, not the procedure itself.

2.4 Correct preparation

A laminar airflow workbench (LAFW) is a sterile working environment for drug preparation. It is commonly named as a laminar flow hood or a laminar flow cabinet in the nursing field. Lacher (2010) clarifies that correct use of the work benches prevent parenteral

medicines becoming contaminated from foreign particles and possibly pathogenic microbes. To prevent room air to enter the cabinet, there is so called laminar airflow circulating inside the hood (Lacher 2010). Therefore, LAFW's are called aseptic workspaces which allow an appropriate environment for medicine preparation (FDA 2009). Lacher (2010) continues that there are two different kinds of models existing for practical pharmaceutical usage called a horizontal LAFW and a vertical LAFW. The horizontal model use pressurized air to blow filtered air from a back panel toward the preparer through a high efficiency particulate air (HEPA) filter. The vertical model on the other hand uses the filtered air blow from top of the cabinet toward table area. Therefore, this technique ensures enhanced safety, rather than the horizontal airflow toward the preparer when handling a cytotoxic drugs or antibiotics. Moreover, vertical cabinets are also called biological safety cabinets (BSC). (Lacher 2010.)

Preparing a medicine for the intravenous therapy aseptically in the laminar airflow workbenches is important considering the patient safety. Lacher (2010) claims that the vertical LAFW needs to be well developed and requires the maintenance of clinical skills for proper use. According to Lacher (2010), a correct position of equipment and handling is crucial for safe and clean medicine preparation. It is recommended to have the LAFW placed farthest possible place in room away from the doors and generally used area. The placement ensures the room air to be free of any particles. All working area is swiped clean with either 70% isopropyl alcohol or the cleaning liquid provided by hospital guidelines. In order to ensure effective and aseptic medicine preparation, only those materials which are needed are to be taken into work surface. Preparation should be performed at least 15cm inside the cabinet area to prevent possible contamination from the preparer body. Furthermore, naturally coughing and sneezing is aimed off the hood. Critical area while working is space between the sterile material and filter. Before handling medical equipment, a hand wash should be performed, gloves are either factory clean or sterile depending on the hospital policy and on the drug being prepared. Moreover, when preparing the cytotoxic or hazardous drugs additional personal protection safety equipment is to be used. (Lacher 2010.) According to the hospital policy these can be eye protection, an apron with long sleeves, or a personal protective hood.

2.5 Documentation

Single-handedly one of the major cornerstones of safe administration is documentation; including labeling the medication during preparation and documenting the placement and the specifics of the IV line (Ahlqvist, Berglund, Wirén, Klang & Johansson 2009). Accord-

ing to The Royal Children's Hospital (2012), the clinical guidelines state that all IV infusions should be correctly labeled, and should feature at least date, time, the patient's name and the signature of the nurse who prepared them. The study conducted by Ahlqvist et al. (2009) found that any kind of documentation happened only in 70% of the cases. However, the information that was recorded may have been insufficient. Furthermore, they conclude that sufficient documentation should include the side and the size of the catheter lumen. Moreover, they cite other studies, which suggest that the signature and time of insertion should be included, as this is part of the critical information if complications should arise. (Ahlqvist et al. 2009.)

2.6 Accurate administration

The nurse is responsible for determining a correct flow rate for the intravenous therapy. Berman and Snyder (2012: 1492-1493) state that the nurse is in charge of correct calculation for drop factor or flow rate in order manage the prescribed the medication accordingly. Depending on the solution and medication given the drop factors are either in milliliters per hour (ml/h) or in drops per minute (gtt/min). Both measure the same infusion rate but using a different scale. Moreover, gtt/min is used more with a manually set drop rate rather than ml/h which is commonly used with the infusion control devices. Nurse calculates gtt/min by adjusting a tubing clamp and calculating drops to the drip chamber for 15sec and multiplying that by 4. The Infusion pumps are manually programmed to correct dosage, thus the pump itself adjust flow according to program. However, factors related to flow rates are closely connected to the maintenance of patency of cannula. Depending on the placement of cannula the position of the arm can block or slow the rate. Occlusion of the cannula or too low height of the infusion bag results in decreased flow rate. (Berman & Snyder 2012: 1492-1493.) According to Rodney and Becker (2006), incorrect administration was due to the human error in programming the infusion devices. Although, Husch et al. (2005) found that drop rate fluctuation in the intravenous therapy are less common than with other types of possible hazardous actions such as wrong order, documentation, labeling and patient identification. According to the Institute for Safe Medication Practice (2011), the time-critical medication should be infused within 30 minutes before or after of the prescribed time due to potential harm or subtherapeutic effect.

2.7 Cannula maintenance

An infusion administration sets are crucial part of the intravenous therapy. Infusion set consists of a protective cap inserted to the catheter, a tubing with ports, a valve clamp, a drip chamber and an insertion spike inserted to the infusion bag or bottle (Berman &

Snyder (2012: 1484). This final project observes the occurrence of the changing infusion sets, aseptically maintained empty infusion set, flushing the tubing to remove air after preparation of the infusion and existence of the infusion remnant both in preparation phase and in administration. Smeltzer et al. (2010: 2129) state that the infusion sets are aimed to change every third day, albeit after the blood infusion change is at the latest 4h or in case of use the lipid emulsion set is changed in 24h. HUS (2013) agrees with 24h interval for lipid solutions but uses four-day intervals in changing for the traditional infusion and for the blood product set are to change latest in 6h. HUS (2013) guide, that infusion tubing is forbidden to hang freely touching the floor to avoid contaminating of the tubing. Berman and Snyder (2012: 1489) inform that in preparation phase flushing the tubing with solution until all air bubbles are removed.

The Intravenous catheter care is important and should be conducted in a daily basis in nursing activities to prevent occlusion, complication and secure accurate intravenous therapy. There is, according to Smeltzer et al. (2010: 307), local complications like: infiltration, extravasation, phlebitis, thrombophlebitis, hematoma and clotting of the needle involve in the intravenous therapy. These are related to negligent care of the intravenous cannula. This final project concentrates only on checking patency of the intravenous cannula and condition of the skin at vicinity of the cannula entry. Fakih (2013) states that the additional increase in knowledge through schooling decrease evidence of the phlebitis. Fakih (2013) continues that focus on catheter care and maintenance have important role for decreasing complication comprehensively. Additional information was provided by HUS (2013) guidelines, which state that the catheter site and adhesive dressing condition is assessed daily basis. Berman and Snyder (2012: 1485) and HUS (2013) guide that the check of the cannula patency is to be done by flushing it with the normal saline (NaCl 0,9%). The cannula port is according to HUS (2013) is to be swiped clean with minimum 70% alcohol based antiseptic solution.

2.8 Database search

The two main database search engines used to locate the articles were CINAHL and Medline. The preliminary database search with the topic of the final project and observation chart lead us to identify the keywords. The keywords that were selected are: accuracy, peripheral medication, intravenous therapy, preparation and administration, for the article search were chosen. (Refer to Appendix 1, table I.)

3 Purpose, aim and research question

The purpose of this final project was to describe the existing practices in intravenous therapy in a hospital environment. Furthermore, the aim will be to generate knowledge on the intravenous therapy in a HUCHS hospital ward. Research question of this final project is how intravenous therapy is realized in practice.

4 Method

4.1 Structured observation

The structured observation was chosen as the quantitative method to record the findings which are divided to set theme categories. The theme categories are established when the research question is defined and pre-existing literature is known. Thus it requires practice and knowledge of the existing information about the phenomenon at hand before the investigators can collect the data. Furthermore, in order to observe both the correct and flawed methods in practice, the observers must know enough about the procedure and theme categories. (Vilkka 2006: 38-39.)

However, structured observation is seen unreliable in quantitative research due to the fact that observations are unique, one-time instances. This means that the situation cannot be repeated exactly as it was. Therefore, the findings can be seen as part of the complex reality. To increase the reliability of the study, at least two observers are needed to observe at the same time the same instance and to cross-check the categories. Structured observation can produce raw data that can be analyzed. (Robson 2009: 84; Vilkka 2006: 38-39.)

The structured observation is categorized as ‘’no concealment without interventions’’ which essentially means that the participant has an informed consent of the research and that observers do not participate actively to the observed situation. However, the risk is that the participants are aware of the observation which immediately affects their behavior and this may have an effect to the results. (Lobiondo-Wood&Haber 2002: 298-299.)

4.2 Instrument

TOLA-project has developed a specific observation chart for this method. It has been modified in a project meeting on the 6th November 2013. It entails in total of 60 questions from 5 different themes. The themes consist the questions of the background of observed

situation, personal hygiene, aseptic technique, the correct preparation, accurate administration, and cannula maintenance. Observation chart uses only yes/no answers for specifically observed topics. In the observation chart, there is space for comments if the situation requires it. (Appendix 1, table II).

4.3 Data collection

The data was collected in a ward specialized in infectious diseases in a HUCHS hospital. The observation chart was used to record the whole process from preparation to administration of intravenous medicine. A letter was sent prior to pilot testing and observation to gain an informed consent from the staff and the administration. Furthermore, the ward was visited and the work and the collaboration project were presented. Additionally, the chart was pilot-tested prior to recording the results. Observation concentrated only on observing the preparation and administration of intravenous drug therapy using an existing observation chart.

Observation took in place September 2014 between days 1.9.2014 to 9.9.2014. In total five different days was used for observation. Observation was performed mainly from morning to afternoon. One weekend was included into the five days. Total observation time was 40 hours. Amount of the completed preparation and administration was 19 (N=19). Continued infusions were excluded from the observations due to the continuous nature of the infusions which means that there is no break between medications nor rinsing of the infusion set.

4.4 Data analysis

The gathered data was analyzed by calculating frequency of the similar observation (YES or NO) per item and finding out mutual cohesion shown as a percent per item. This percent is dogmatized as internal consistency in this project as the percent number (YES%, NO%) illustrate identical answers compared to each other. The times where one of the observers had zero observed instances, the internal consistency is considered to be zero percent. Items and the respective answer percentages are cross tabulated later in the project. Although, there was no comparison of YES and NO answer to each other.

5 Results

5.1 Personal hygiene

Generally speaking, the appearance and personal hygiene of the nurses were up to the current standards. Both observer 1 (n=25) and observer 2 (n=23) were consistent with the results.

Table 2: Chart of the observed personal hygiene

	YES O1	NO O1	YES O2	NO O2	YES (n)	YES %	NO (n)	NO %
10. Long hair are tied up	6	0	7	0	13	85,71 %	0	100,00 %
11. Jewelries	0	25	0	23	0	100,00 %	48	92,00 %
12. Rings	0	25	0	23	0	100,00 %	48	92,00 %
13. Wristwatch	0	25	0	23	0	100,00 %	48	92,00 %
14. Nail polish	0	25	0	23	0	100,00 %	48	92,00 %
15. Artificial nails	0	25	0	23	0	100,00 %	48	92,00 %
16. Skin condition on hands is good	25	0	23	0	48	92,00 %	0	100,00 %
17. Other: uniform according to hospital policy (no jacket etc.)	25	0	23	0	48	92,00 %	0	100,00 %

In the first question, nearly all the staff members had short hair which was defined by anything shorter than shoulder length hair and the few who did, had had it tied up. Overall, the discrepancies between the number of people (85,71% and 92% internal consistencies) are explained by the fact that the preparation and administration were done by two or three different persons and most likely some may not have been added by observer by accident. Skin condition was considered to be good if there were no visible abrasions or cuts or anything pointing to a recent injury (Band-Aid, gauze) that could be considered as a platform for microbes. Hospital provides to all of its employees short-sleeved uniforms. No one was observed to wear a long-sleeved coat.

5.2 Hand hygiene

Hand hygiene is regarded as one of the most influential item to reduce hospital acquired infections. The ward is very conscientious about routine hand hygiene, although there are some instances where the disinfection is disregarded. Specifically, the general trend was that disinfection did not occur after the removal of the gloves. However, most of the time the staff had very good hand hygiene and they did remember to disinfect their hands both before and after patient contact. The discrepancies between hand washing was due to an error in interpretation by observer 1. It was seen as a continuum to the question 23 and therefore was not noted.

Table 3: Chart of observed hand hygiene.

	YES O1	NO O1	YES O2	NO O2	YES (n)	YES %	NO (n)	NO %
18. Disinfection before preparation of drug	18	4	14	9	32	77,78 %	13	44,44 %
19. Before patient contact	21	13	25	8	46	84,00 %	21	61,54 %
20. After patient contact	18	7	15	12	33	83,33 %	19	58,33 %
21. Before wearing protective gloves	24	3	18	5	42	75,00 %	8	60,00 %
22. After removal of protective gloves	18	14	9	13	27	50,00 %	27	92,86 %
23. Hands are not visibly soiled, if yes fill in Question 24*	25	0	19	0	44	76,00 %	0	100 %
24. Other: * hands have been washed	0	25	7	14	7	0%	39	56,00 %

The general trend on the ward is to disinfect the hands between the different phases in the preparation of the medication and nursing interventions. Discrepancies between the observers (n=23 and n=22) are due to the fact that some medicine from the total of 19 were mixed before preparing the medication to the patient. According to the results, the staff did disinfect their hands consistently both before and after patient contact, and there is only a slight variation between the consistency percent (83% vs 84%) regarding the YES answer. In item 20 and 21, the disinfection does occur and it is relatively consistent with the recommended guidelines. In item 22, there is a small decrease in the numbers and staff disregards this item the most. Hands were never visibly soiled at any point, and the discrepancies are due to the problems with the visibility and due to the marking differences. In item 24, the staff was seen to wash their hands after the removal of the gloves, however, it was not linked to the soiled or filthy hands. Furthermore, observer 1 did not consider those instances related to the item 23 and did not mark them down.

5.3 Hand hygiene technique

According to the observed data, the actual practice is not up to the recommended guidelines. Because the positioning of the staff relative to the observers in the patient rooms was less than optimal, which made the observation very difficult and it caused major discrepancies between the two observers. However, some significant parallels could be seen in the shortcomings in the technique. The most disregarded parts were the fingertips, webbing and thumbs. For the great majority, the process did not last long enough (for 30 seconds) and in some cases there was not enough of hand gel applied. Hand gel was generally applied to dry hands.

Table 4: Chart of observed hand hygiene technique.

	YES O1	NO O1	YES O2	NO O2	YES (n)	YES %	NO (n)	NO %
25. Rubbing fingertips against palm	0	50	5	52	5	0%	102	96,15 %
26. Rubbing interlaced fingers palm side	56	7	37	14	93	66,07 %	21	50,00 %
27. Placed right hand over left's knuckles while chafe interlaced hands and vice versa	9	43	4	52	13	44,44 %	95	82,69 %
28. Rubbing both thumbs separately	24	28	13	44	37	54,17 %	72	63,64 %
29. Rubbing flexed fingers together	3	48	9	41	12	33,33 %	89	85,42 %
30. Lasts long enough (30 second)	3	75	0	57	3	0%	132	76,00 %
31. Enough of hand gel is being applied (3-5ml)	24	53	40	20	64	60,00 %	73	37,74 %
32. Hand gel is applied to dry hands	77	1	57	1	134	74,03 %	2	100,00 %

There is a 74% consistency in observing the appliance of the disinfectant. In all but 1 case, the hand gel was applied to dry hands. Discrepancies are due to the fact that some of the occurrences are not observed at all and thus not marked at all. The length of the use of the disinfectant was almost always too short (n=75 vs n=57) and in the few cases the staff was observed doing something else at the same time while applying the disinfectant. In regards of the technique of applying, the item 26 was observed the most despite of the internal inconsistencies and everything else was conducted offhandedly.

5.4 Preparation of the medication

The ward employs a pharmacist who takes care of the medications and storage. This is why the observers assume that the drugs are up to date and stored appropriately. The infusion labels were usually printed and thus considered to be according to their local policies. It was observed that the right medicine was used. Observers did not have the opportunity to check the right dose and the residual infusion as the packaging was disposed immediately after the preparation. The medicine room had a laminar airflow workbench in its own small room, the staff was reluctant to have observers in the very narrow space as it would become too crowded to work in. The item 41, the residual was observed only once by observer 2, otherwise it was not seen as the containers were disposed immediately. The protective equipment in the laminar airflow cabinet was not used at any point. The gloves were used, however, they were only factory clean thus not counted and marked as NO.

Table 5: Chart of observed preparation of the medicine.

	YES O1	NO O1	YES O2	NO O2	YES (n)	YES %	NO (n)	NO %
34. Correct drug	19	0	19	0	38	100,00 %	0	100.00 %
35. Correct dose	19	0	19	0	38	100,00 %	0	100.00 %
36. Gloves were used while preparation	18	2	14	5	32	77,78 %	7	40,00 %
37. Infusion set does not contain air after assembling	6	0	9	0	15	66,67 %	0	100.00 %
38. Drug has not expired	19	0	19	0	38	100,00 %	0	100.00 %
39. Drug is stored correctly	19	0	19	0	38	100,00 %	0	100.00 %
40. Drug container perforated surface is cleaned with antiseptic agent before attaching transport cannula or infusion set	25	11	20	3	45	80,00 %	14	27,27 %
41. Residual infusion	0	0	1	0	1	0%	0	100.00 %
42. Drug container is marked according to local policy	19	0	19	0	38	100,00 %	0	100,00 %
43. Drug storage time before administration is appropriate according to instructions	19	0	19	0	38	100,00 %	0	100,00 %
44. Laminar airflow cabinet, apron	0	19	0	19	0	100,00 %	38	100,00 %
45. Laminar airflow cabinet respirator	0	19	0	19	0	100,00 %	38	100,00 %
46. Laminar airflow cabinet Sterile gloves	0	19	0	19	0	100,00 %	38	100,00 %
47. Laminar airflow cabinet Nursing cap	0	19	0	19	0	100,00 %	38	100,00 %
48. Laminar airflow cabinet Sterile drape	0	19	0	19	0	100,00 %	38	100,00 %

Gloves were generally used while preparing the drug, however there were few instances when the gloves were not used at all. The containers were generally cleaned with the antiseptic agent while preparing the medication, however the practice varied when attaching the infusion set to the container. In every case, the drug storage times were correct and appropriate according to the instructions provided by the pharmaceutical company.

5.5 Administration of the medication

According to the ward's informed local policy, the old infusion sets were replaced every morning unless otherwise specified. The old sets were aseptically preserved in every case. Identity checks on patients were hardly done. Rinsing of the infusion set was completed every time after the medication. Generally the infusion was given in a correct time span.

Table 6: Chart of observed administration of the medication.

	YES O1	NO O1	YES O2	NO O2	YES (n)	YES %	NO (n)	NO %
50. Use of old infusion set	13	6	15	4	28	86,67 %	10	66,67 %
51. If old set, is it aseptically preserved in stand	13	0	15	0	28	86,67 %	0	100,00 %
52. Patient identity is checked	4	15	2	17	6	50,00 %	32	88,24 %
53. Correct time (minutes from prescribed time)	16	3	16	3	32	100 %	6	100,00 %
54. Correct infusion drop rate	16	3	19	0	35	84,21 %	3	0%
55. Residual infusion	0	0	7	0	7	0%	0	0%
56. Rinse of infusion set	19	0	19	0	38	100 %	0	0%

5.6 Cannula maintenance

At the ward, the cannulas were flushed before and after the medication administration. The observers considered the cannula to be usable if it remained functional during the whole process of the infusion. The skin was rarely checked around the vicinity of the cannula; the dressings and the cannula tape often blocked the visibility.

Table 7: Chart of cannula maintenance.

	YES O1	NO O1	YES O2	NO O2	YES (n)	YES %	NO (n)	NO %
58. Cannula is usable	19	0	19	0	38	100 %	0	100,00 %
59. Skin around cannula site is healthy	2	17	0	19	2	0%	36	89,47 %

The discrepancies between the observers in item 59 is explained by the method of interpretation. Observer 1 observed that the dressing was taken off and the cannula was visible for the member of the staff although the angle of the observers was unsuitable to check the skin.

6 Validity

Validity is a concept, which means the cohesion between the instrument (''the observation chart'') and the phenomenon (''administration of intravenous therapy''). In order to ensure the validity, the instrument has been accepted and designed for specific purpose. (Burns and Grove 2007: 365.) Internal validity is defined as possibilities or biases which

may affect the results in the data collection and sample selection, interpretation and analysis. External validity is defined as results that are capable to represent larger group than just objects of the study. (Moule and Goodman 2009: 196-197.)

In the data collection phase, it seemed to be of good practice to not to be too close to the objects of observation in order to keep the observation reliable. This was part of the observer's internalized concept of the research methodology. As an example, some of the staff felt the presence of the observers to be disrupting their work by being too close despite of the fact that they could have refused to participate in the observation. In order to respect the members of the staff participating to the project, the observers maintained distance. Furthermore, in order to not to reveal to the staff the observed items, the observers tried to remain passive when the items of interests occurred and to not to affect the situation too much through actions. The sample selection was straightforward and followed the time of administration, thus whomever prepared and administered was observed unless the participant would have refused to participate.

The validity of this final project cannot be considered to be definite. The cohesion between the instrument and the phenomenon in an observation can only be consistent if both observers understand the items and the phenomenon is clear. In this final project, the phenomenon is affected by many internal and external factors such as the presence of the observers, the emotional state and the attitudes of the staff and the observers' concept of research methods. As an example, residuals either in the containers or in the infusion lines are very difficult to determine and to evaluate whether it can be considered to follow the standards of the drug therapy. In containers, the impression by the observers is that depending on whether it is an ampoule or a glass bottle, the amount of residual varies and it is to be expected that this has been considered by the pharmaceutical companies. Furthermore, even in the plastic containers such as the sodium chloride 0,9% 100 ml bottle may contain residual despite of the attempt of emptying it.

The analysis of the results was challenging as the deviation was great. As an example the hand hygiene technique was difficult to observe because the staff members often turned their back on the observers and the movements could only be seen partially. Furthermore, the one-sided hand hygiene techniques were very prevalent which may have caused an observer to mark it as something that occurred.

The staff members at the ward are relatively consistent and homogenous in their working behavioral trends. Although the work behavior can be limited to the work place and in its community, similar trends can be seen in other health care units. Thus the sample size may be generalizable to the other communities as well.

7 Reliability

Reliability may be problematic when a structured observation is being used. The observations are one of a kind instances that may not be repeatable exactly as they were observed, and the differences in the interpretation may occur during the observation between the two data collectors. At least two observers are needed to increase the reliability of the study. (Robson 2009: 84; Vilkka 2006: 38-39.) Reliability is concept to evaluate similarities between data in cases where the observers have used an identical observation tool. Reliability includes three different parts: stability, internal consistency and equivalence. Stability is defined as consistency with the results even when the tool is used in different times or in different settings. Internal consistency is defined as accuracy to measure the same item identically. Equivalence is also known as inter-rater reliability which is defined as a coherence between two observers while using the identical tool. (Moule & Goodman 2009: 186-187.)

The stability was confirmed by visiting the ward during weekdays and during one weekend. This ensured the use of the tool in different time and setting. The same instrument has been used by the other student groups who participated to the TOLA project.

The internal consistency of the final project varies between the different themes and items. As an example, the numbers of personal hygiene were different (O1 n=25, O2 n=23), however, the same phenomenon occurred in all the instances and were identical between the two observers. Accuracy was very difficult to achieve in cases where the positioning and angles were not optimal and the optimal angles may have had influence to the staff's behavior or even occur as disrupting e.g. standing in front of the staff.

The inter-rated reliability, or the equivalence, was not very satisfactory due to the similar problems as in the internal consistency. Most notably there may have been misunderstandings about the definitions of the items in the observation chart despite of the pilot testing. Some of the items were more prone for free interpretation and due to the assumptions of the two observers, they were not discussed adequately. Although the results were similar and the major trends were effortlessly established, the final project lacked consistency in order to produce reliable data.

The observation method is not just a research method, a mean to an end, but it was a process of learning. It began with understanding the method itself and investigating the literature. However, this was not the extent, and the observation required thought and

discussion. The discussion was not adequate enough despite of the substantial information which caused misunderstandings which are visible in the results. Furthermore, the observation was challenging as the environment might not be optimal. Thus observers need to be uniform about their instrument and the following actions to ensure the reliability.

8 Ethics

In order to maintain the final project the data collection and analysis need to be valid and reliable. To achieve this the methods in use are required to be proven and well known. Tutkimuseettinen Neuvottelukunta (2012) guidelines underline the importance of good ethical practice in scientific research. The ethics involve multiple aspects of the research process. Honesty, diligence and accuracy should be followed in all of the phases. The literature search should be conducted by using appropriate and relevant databases to the field. Furthermore, plagiarism needs to be avoided by the use of correct referencing. For the data collection, the research permit has to be acquired from the relevant authorities. Moreover, diligence and accuracy are the cornerstones of recording of the data and presenting of the results. (Tutkimuseettinen Neuvottelukunta 2012.) The participants' self-determination and confidentiality should be preserved at all times by acquiring informed consent. Privacy and dignity, right to anonymity and confidentiality, protection from harm and discomfort must be ensured through the data collection phase. In right to privacy and dignity, the information obtained is handled in sensitive and respective manner. In right to anonymity and confidentiality, the subject or the participant cannot be identified from the data and results. In right to protection from harm and discomfort, the harm or the uncomfortable situation is minimized. (LoBiondo-Wood & Haber (2010: 250, 252-253.)

The final project was planned and executed according to the standards in the nursing science. Research project permission was acquired for the final project from the head nurse of the department of medicine in HUCHS. The agreement of confidentiality was signed, which will retain the patients' and the staff's anonymity and privacy.

Ethical dilemmas were very few as the focus was on the process instead of the people or things which is why the participants were not asked for a written permission. The ward was informed prior to the data collection. At the same time, the data collection method was discussed and the staff had an opportunity to discuss any problematic issues at hand. The staff was given a chance to decline from participating to the final project, but

in the data collection phase this option was never used. Privacy was respected by keeping the distance if some of the staff expressed their wish to do so. It did not seem to impact the data collection in a negative light, thus their wish was granted. Any information related to the observation chart was not given as to keep the disruption to the normal behavior minimal. Furthermore, the observers did not interfere to the interventions by talking or participating. Anonymity was retained at all times and the participants cannot be identified from the personal information acquired (work experience in years, professional title). The charts were numbered, so that no personal information was given away.

The analysis of the results was conducted according to the collected data and it was reported as it was observed recorded. This is part of the scientific research methods regarding the structured observation. The results will be made public for target audience; the wards, other HUCHS hospitals, other students and TOLA project collaborators. This will ensure the transparency in the final project for future use or even criticism.

9 Discussion

According to the ten rights of medication, the staff adhered the rights relatively well. It can be considered advantageous to have a pharmacist on the ward to maintain the medication room. The practical matters regarding drug therapy such as labelling, storing and maintenance were easier to manage when there is someone specifically appointed to that duty. The patient medication lists were found to be easy to follow and to check as they were printed lists separated from each other.

The most lacking issue in the ten rights was the identification of the patients. During the observation, only few (n=4 and n=2) were seen or heard to check the identity of the patient at any point. The times when it was observed, it was an informal conversation between the patient and the staff and the patient was addressed by first name. A probable reason for not identifying patients may be explained by the impression that the same staff took care of the same patients in different shifts, thus they were knowledgeable about their patients. Thus, the majority of the staff know the patients beforehand and can recognise them. Furthermore, the patients have multiple infusions per day, which makes constant identification redundant and unnecessary. The treatment was seen to be very intensive and this enables the staff to become more familiar with their patients and their issues.

Overall, the ward has a good level of personal hygiene. The staff had an understanding of what is appropriate wear on the ward. The long hair was always tied up, the rest had

shorter hairstyles that did not get in the way nor contaminate during interventions. The skin on the hands was always intact and in good condition. The hands were never seen to be soiled prior to the patient contact. There were only few instances where the hand washing procedure was seen, but none of them were related to hands being visibly soiled. Observer 2 interpreted hand washing to be an alternative choice for hand sanitizer, as there seemed to be no other rationale for it. Some of the staff preferred to wash the hands instead of using the hand sanitizer when there was no patient contact nor a risk for soiling. The nails were observed to be short and none of the staff wore artificial nails. The only accessories observed were small earrings and seldom a small necklace. It was not seen to be aseptically problematic to wear previously mentioned jewellery. All the uniforms had short sleeves.

There was generally a positive trend in the use of disinfectant before protective gloves. The neglects in the use of hand sanitizer occurred when the gloves were not removed after the preparation of the medication or when the gloves were removed. The impression was that the gloves gave a false sense of security of the practice of asepsis. In couple of instances, the staff was seen to exit the medicine room with the protective gloves and prepared medication to the patient room to start the infusion. However, in those instances the staff did not touch the surrounding area with the exception of the equipment, but it can be seen to compromise the hygiene practice. Another observation was that it was a matter of personal preference whether to use protective gloves at all, and it did not seem to be related to the qualities of the medication.

Despite of the positive trend in disinfecting hands both before and after patient contact, the staff was observed to move freely between different patient beds without disinfecting hands first. However, this was not intentional and it seemed fair to assume that this is due to the nature of the work. Shortcuts are being used in order to be efficient which in the great scheme of things may compromise asepsis. It was also observed that when the patient contact ends, impression was that the staff did not see it problematic to touch the surroundings without disinfecting the hands. The process of administration the medication involves the use of infusion sets and pumps, the equipment which can become platforms for microbial growth as well. Even though the equipment is part of the surroundings and it is a separate entity from the patient, it left an impression that they were seen as one.

In the observation chart, there are five different phases for the technique and three separate ones for the duration, amount and dryness. In the technique, item 26 and 28 were

practiced in the majority of the cases. Everything else was either missing or very rarely observed. The phases were usually rough and were sometimes executed only on one hand. Primarily, the observed technique involved rubbing the dorsum, over the conjoined fingers neglecting the webbing completely. Fingertips were never handled separately and sometimes only one thumb was separately rubbed. Furthermore, the interlocked, flexed fingers were hardly seen either. Moreover, this seemed to be the case in all of the staff members and it was seen as appropriate practice in unison, most likely unintentionally. The observers were left under the assumption that this was the most efficient and the fastest technique to disinfect the hands. Moreover, the most challenging part in observing occurred when the member of the staff turned their back on the observers and only the movement of the shoulders could be seen. This made it impossible to observe the actual hand movement although you could estimate the duration.

The duration of the disinfection was without a doubt too short when compared to the recommended 30 second practice. The time was never measured with a timer as it might compromise the objectiveness of the final project. Those few instances that observer 1 estimated to attain the 30 second mark when the member of the staff was walking down the corridor without touching any objects. Another observed practice was to wave hands to dry the hands faster which affected the technique as well.

The estimation for the amount of the used hand gel was very tricky to observe. The golden standard is 3 to 5 ml of disinfectant. In the patient rooms that were used for observation, did not have automated disinfectant dispensers, but manual pumps. 5 ml is seen as 2 presses on the manual pump dispenser. However, the manual dispensers are not very accurate and the amount can vary depending on how long the handle is being pressed. Thus hand gel was being used, but not necessarily according to the guidelines and policies. Observers were not in agreement with the amount of applied hand gel; observer 1 considered one pressing to be inadequate (considered to be less than 3 ml) whereas the observer 2 considered one pressing to be adequate. In some cases, the staff was seen to use two short presses or one long press, so the practice and the amount in milliliters varies.

A laminar flow cabinet was used in the preparation of parenteral medication. There is a separate room reserved for the cabinet next to the medication room for easy access to a safe and clean environment. The room was relatively small, so the observers remained outside of the room, observing from the small window on the door. Furthermore, the staff preferred not to have the observers in the room. The cabinet itself was a horizontal

model. The staff consistently used only factory clean, protective gloves as a protection. It was not informed whether or not the hospital policy dictated the use of other protective equipment such as sterile drape, apron and eye protection. The observers felt that the observation influenced more or less in the behavior of the staff when using the cabinet such as doors were left open for the observers.

Preparation of the medicine was well executed in the ward and there were very few problematic areas that were noted. There was a positive trend in using the hand sanitizer before the preparation, and this was consistent in all the members of the staff. The medications were prepared by using gloves, although in few instances the gloves were not used at all but replaced with hand sanitizer. During the preparation of the medicine, the drug containers themselves were wiped with antiseptic solution although in few instances the solution was sprayed on the container. The residual infusion was challenging to observe as all the containers were disposed immediately, however, in one instance the residual could be seen in the bottle due to a favorable angle. The amount of residual in the drug containers is very difficult to determine as there can be varying amounts left in the container due to the method of mixing. The observers felt that their subjective views were not enough to make an accurate reflection of the practice.

The infusion sets were changed every morning regularly. The assembling of the infusion sets were up to recommendations when observed. There were only few instances where the observers could see clearly that there were no air bubbles in the lines at all, as most of the staff held them in their hands which decreased the visibility and they were efficient in the process. The old infusion sets were preserved aseptically on the pole and the lines never touched the ground.

The accuracy of the administration was on a good level, however, there is still room for improvement. The drugs were prepared and the storage time were according to the pharmaceutical companies' recommendations which was checked individually from reliable sources. The common practice is to prepare the medication and administering it right away unless there were some hindrances. Despite of the occasional hindrances, it never crossed the assigned time line for the storage time. The drug administered was most often infused within the prescribed time line, however, in some occasions the 30 minute time limit was exceeded. The administered time varied from exact figure to 47 minutes from the prescribed time. The observers influenced on this as some of the staff waited before administration in another room was completed.

The correct infusion rate was achieved by using the infusion pumps. This was generally the practice at the ward, as the infusion pumps can deliver more efficient and accurate medication management. The manual drip stands were used in three occasions in which the infusion rate was not seen as accurate enough. However, observer 2 felt that if the infusion was delivered within the prescribed time line, it was seen as accurate. However, it can be argued that the manual setting of an infusion is never accurate and is completely based on an estimation unless it is calculated gtt/min which was never witnessed at the ward.

The infusion sets were rinsed each time after a drug infusion. This was a predominant policy at the ward, nonetheless there was no information on how much rinsing solution should be used to ensure no residual remains in the infusion line. Only 7 drug containers were seen to possess residual by one observer, however, this was challenging as the containers were disposed immediately after disconnecting the infusion lines from the cannula.

The cannula maintenance was very difficult to evaluate. The cannula was flushed before attaching the infusion lines and after disconnecting the rinse. However, the impression was that it was routinely conducted action out of habit than checking the patency of the cannula. The assumption was backed up by the fact that the site of the cannula was not examined nor assessed. However, it should be noted that it was never inquired if the ward had their own policy in regards of this matter. The staff did ask if the patient had any complaints of pain during the patency check, but it is unclear whether or not this is enough to be considered as an assessment. The opportunity for skin check occurred twice according to observer 1 when the protective dressings were taken off. Observer 2 did not mark them down because it was unclear whether or not they assess it appropriately or not.

All in all, the observation studies related to accurate preparation and administration of intravenous therapy are important to conduct in order to develop awareness of the problematic areas in this field and to keep educating the staff. However, the limitation of an observation becomes apparent when the challenges of the reliability occur frequently. Thus it is important to remain critical of the results and to understand that the general trends are only suggestive. One of the weaknesses of the final project is the small number of instances observed. Furthermore, in the future, extensive pilot-testing prior to the actual data collection may increase both the validity and the reliability.

10 References

Ahlqvist, M., Berglund, B., Wirén, M., Klang, B. and Johansson, E. (2009) Accuracy in Documentation – a Study of Peripheral Venous Catheters. *Journal Of Clinical Nursing.* 18. 1945-1952.

Aschenbrenner, D. and Venable, S. (2009) *Drug Therapy In Nursing 3rd ed.* Philadelphia: Lippincott William&Wilkins.

Berman, A. and Snyder S. (2012) *Kozier & Erb's Fundamentals Of Nursing -Concepts, Process and Practice 9th ed.* New Jersey: Pearson Education.

Burns, N. and Grove, S.K. (2007*) Understanding Nursing Research 4th ed.* Missouri: Saunders Elsevier.

Carson, D., Dychter, S., Gold, D. and Haller, M. (2012) Intravenous Therapy: A Review Of Complications and Economic Considerations of Peripheral Access. *Journal Of Infusion Nursing.* 35(2). 84-91.

CDC. (2002) *Guideline for Hand Hygiene in Health-Care Settings*. Centers for Disease Control. Internet document. <http://www.cdc.gov/mmwr/PDF/rr/rr5116.pdf.> Read 05.11.2013.

Fakih, F., Jones, K., Ray, J.E., Takla, R.,Szpunar, S., Brown, K., Boelstler, A. and saravolatz, L. (2013) Peripheral Venous Catheter Care in the Emergency Department: Education and Feedback Lead to Marked Improvements. *American Journal of Infection Control.* 43:531-536.

FDA. (2009) *U.S. Department of Health and Human Services Food and Drug Administration Center for Drug Evaluation and Research*. PET-drugs- Current Good Manufacturing Practice (CGMP). Internet document <http://www.fda.gov/downloads/Drugs/GuidanceComplianceRegulatoryInformation/Guidances/ucm070306.pdf>. Read 16.10.2013.

HUS. (2013) *5.4 Perifeerinen verisuonikanyyli*. HUS Infektiosairauksien klinikka. Guidelines.

Husch, M., Sullivan, C., Rooney, D., Barnard, C., Fotis, M., Clarke, J. and Noskin, G. (2005) Insights from the Sharp End of Intravenous Medication Errors: Implications for Infusion Pump Technology. *BMJ Quality and Safety*. 14:80-86.

Institute for Safe Medication Practice. (2011) *ISMP Acute Care Guidelines for Timely Administration of Schedules Medications.* Internet guideline. <http://www.ismp.org/tools/guidelines/acutecare/tasm.pdf> Read 16.9.2014.

Kampf, P, and Hollingworth, A. (2008) Comprehensive Bactericidal Activity of an Ethanol-Based Hand Gel in 15 Seconds. *Annals of Clinical Microbiology and Antimicrobials.* 7(2).

Kankkunen, P. and Vehviläinen-Julkunen, K. (2009) *Tutkimus Hoitotieteessä.* Helsinki: WSOYpro.

Lääkeinfo.fi. (2014) Internet source. *lääketietokeskus; Pharmaceutical Information Centre.* http://www.laakeinfo.fi/. Read on 5.9.2014.

Lacher, B. (ed.). (2010) *Pharmacy Technician Certification Review & Practice Exam 3rd Edition*. Bethesda. *American Society of Health-System Pharmacists*. Internet document

<http://www.ashp.org/DocLibrary/Bookstore/P2081/SampleChapterP2081.aspx>. Read 16.10.2013.

Lobiondo-Wood, G. and Haber, J. (2002) *Nursing Research. Methods, Critical Appraisal and Utilization.* 5th ed. St. Louis. Mosby Inc.

LoBiondo-Wood, G. and Haber, J. (2010) Nursing Research. *Methods and Critical Appraisal for Evidence-Based Practice.* 7th ed. Mosby Elsevier. Missouri.

Loveday, H.P., Wilson, J.A., Pratt, R.J., Golsorkhi, M., Tingle, A., Bak, A., Browne, J., Prieto, J. and Wilcox, M. (2014) epic3: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England. *Journal of Hospital Infection.* 86s1:1-70.

Malach, T., Jerassy,Z., Rudensky, B., Schlesinger, Y., Broide, E., Olsha,O., Yinnon, A.M. and Raveh, D. (2006) Prospective Surveillance of Phlebitis Associated with Peripheral Intravenous Catheters. *American Journal of Infection Control.* 34(5):308-312.
Moule, P. and Goodman, M. (2009) *Nursing Research, an Introduction.* London: SAGE Publication ltd.

National Coordinating Council for Medication Error Reporting and Prevention. (2012) *About Medication Errors.* Internet article. <http://www.nccmerp.org/aboutMedErrors> Read 16.10.2013.

Perry, C., Marshall, R. and Jones, E. (2001) Bacterial contamination of uniforms. *Journal of Hospital Infection.* 48:238-241.
Pratt, R.J., Pellowe, C.M., Wilson, J.A., Loveday, H.P., Harper, P.J., Jones, S.R.L.J.,

McDougall, C. and Wilcox, M.H. (2007) Epic2: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England. *Journal of Hospital Infection.* 65:1-64.

Robson, C. (2009) *How to Do a Research Project a Guide for Undergraduate students*. USA: Blackwell Publishing.

Rodney, W.H. and Becker, S.C. (2006) An Overview of Intravenous-Related Medication Administration Errors as Reported to MEDMARX®, a National Medication Error-reporting Program. *Journal of Infusion Nursing.* 29(1):20-27.

Royal College of Nursing. (2013) *Guidance on Uniforms and Work Wear.* Saffron House. London.

Rubb, M.E., Fitzgerald, T. Puumala, S., James, t.a., Graig, R-. Iwen, P.C., Jourdan, D., Keuchel, J., Marion, N., Peterson, D., Sholtz, L. and Smith, V. (2007) Prospective, Controlled, Cross-Over Trial of Alcohol-Based Hand Gel in Critical Care Units. *Infection control and hospital epidemiology.* 29(1).

Smeltzer, S., Bare, B., Hinkle, J. and Cheever, K. (2010) *Brunner & Suddarth's Textbook of Medical-Surgical Nursing 12th ed.* Philadelphia: Lippincott Williams &Wilkins.

Tutkimuseettinen Neuvottelukunta (2012) *Hyvä tieteellinen käytäntö ja sen loukkausepäilyjen käsitteleminen Suomessa.* PDF-dokumentti.< http://www.tenk.fi/fi/ohjeet-ja-julkaisut>. Read 3.10.2014.

Vilkka, H. (2006) *Tutki ja Havainnoi.* Vaajakoski: Tammi.

WHO. (2005) *Global Patient Safety Challenge 2005-2006.* World Health Organization. Clean Care is Safer Care. Internet document. <http://www.who.int/patientsafety/events/05/GPSC_Launch_ENGLISH_FINAL.pdf>. Read 06.11.2013.

WHO. (2009) *WHO Guidelines on Hand Hygiene in Health Care.* World Health Organization. Patient Safety. Internet document. http://whqlibdoc.who.int/publications/2009/9789241597906_eng.pdf. Read 05.11.2013.

WHO. *Health Care-Associated Infections -Fact Sheet*. Internet document. http://www.who.int/gpsc/country_work/gpsc_ccisc_fact_sheet_en.pdf Read 09.10.2013.

11 Appendix

Table I: Database search 16.10.2013

Database	Keywords	Hits, n=	Exclusion criteria*		Selected by title, n=	Selected by abstract, n=
MEDLINE	accuracy AND "intravenous therapy"	7	2		0	0
	accuracy AND peripheral	3015	178	34*	0	0
	accuracy AND peripheral AND intravenous			2	0	0
*Exclusion criteria: 2003-2013, peer review, English language	accuracy AND nurs* AND intravenous	40	2	2	0	0
	nurs* AND intravenous AND environment	122	15		2	0
Total					2	0
CINAHL	accuracy AND "intravenous therapy"	92	69	9*	1	0
	accuracy AND peripheral	6802	4405	4396*	0	0
	accuracy AND peripheral AND intravenous			48*	1	1
* Exclusion criteria: abstract, full text	accuracy AND nurs* AND intravenous	64	59		1	1
	nurs* AND intravenous AND environment		57			4
Total					3	6
Duplicate removed					2	0

Table II: Observation chart

Observation chart of intravenous therapy accuracy and aseptic
1. Background information of observed situation:
2. Professional tittle of worker:
3. Professional experience in years of worker
4. Observers:
5. Serial number of observation
6. Date:
7. Time:
8. Medication
9. Other

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A) Personal hygiene of nurse	Yes	No	Other:
10. Long hair are tied up			
11. Jewelries			
12. Rings			
13. Wristwatch			
14. Nail polish			
15. Artificial nails			
16. Skin condition on hands is good			
17. Other: uniform according to hospital policy (no jacket etc.)			
B) Fulfilment of Hand hygiene			
Hands have been disinfected			
18. Disinfection before preparation of drug			
19. Before patient contact			
20. After patient contact			
21. Before wearing protective gloves			
22. After removal of protective gloves			
23. Hands are not visibly soiled, if yes fill in Question 24*			
24. Other: * hands have been washed			
Appropriate technique			
25. Rubbing fingertips against palm			
26. Rubbing interlaced fingers palm side			
27. Placed right hand over left's knuckles while chafe interlaced hands and vice versa			
28. Rubbing both thumbs separately			
29. Rubbing flexed fingers together			
30. Lasts long enough (30 second)			
31. Enough of hand gel is being applied (3-5ml)			
32. Hand gel is applied to dry hands			
33. Other:			

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C) Preparation of medication	Yes	No	Other:
34. Correct drug			
35. Correct dose			
36. Gloves were used while preparation			
37. Infusion set does not contain air after assembling			
38. Drug has not expired			
39. Drug is stored correctly			
40. Drug container perforated surface is cleaned with antiseptic agent before attaching transport cannula or infusion set			
41. Residual infusion			
42. Drug container is marked according to local policy			
43. Drug storage time before administration is appropriate according to instructions			
44. Laminar airflow cabinet, apron			
45. Laminar airflow cabinet respirator			
46. Laminar airflow cabinet Sterile gloves			
47. Laminar airflow cabinet Nursing cap			
48. Laminar airflow cabinet Sterile drape			
49. Other:			
D) Drug administration			
50. Use of old infusion set			
51. If old set, is it aseptically preserved in stand			
52. Patient identity is checked			
53. Correct time (minutes from prescribed time)			
54. Correct infusion drop rate			
55. Residual infusion			
56. Rinse of infusion set			
57. Other:			
E) Intravenous cannula			
58. Cannula is usable			
59. Skin around cannula site is healthy			
60. Other:			

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Table III: Data template

	YES	NO	YESO2	NOO2	YES (n)	YES	NO (n)	NO
10. Long hair are tied up	6	0	7	0	13	85,71 %	0	100,00 %
11. Jewelries	0	25	0	23	0	100,00 %	48	92,00 %
12. Rings	0	25	0	23	0	100,00 %	48	92,00 %
13. Wristwatch	0	25	0	23	0	100,00 %	48	92,00 %
14. Nail polish	0	25	0	23	0	100,00 %	48	92,00 %
15. Artificial nails	0	25	0	23	0	100,00 %	48	92,00 %
16. Skin condition on hands is good	25	0	23	0	48	92,00 %	0	100,00 %
17. Other: uniform according to hospital policy (no jacket etc.)	25	0	23	0	48	92,00 %	0	100,00 %
18. Disinfection before preparation of drug	18	4	14	9	32	77,78 %	13	44,44 %
19. Before patient contact	21	13	25	8	46	84,00 %	21	61,54 %
20. After patient contact	18	7	15	12	33	83,33 %	19	58,33 %
21. Before wearing protective gloves	24	3	18	5	42	75,00 %	8	60,00 %
22. After removal of protective gloves	18	14	9	13	27	50,00 %	27	92,86 %
23. Hands are not visibly soiled, if yes fill in Question 24*	25	0	19	0	44	76,00 %	0	100,00 %
24. Other: * hands have been washed	0	25	7	14	7	0%	39	56,00 %
25. Rubbing fingertips against palm	0	50	5	52	5	0%	102	96,15 %
26. Rubbing interlaced fingers palm side	56	7	37	14	93	66,07 %	21	50,00 %
27. Placed right hand over left's knuckles while chafe interlaced hands and vice versa	9	43	4	52	13	44,44 %	95	82,69 %
28. Rubbing both thumbs separately	24	28	13	44	37	54,17 %	72	63,64 %
29. Rubbing flexed fingers together	3	48	9	41	12	33,33 %	89	85,42 %
30. Lasts long enough (30 second)	3	75	0	57	3	0%	132	76,00 %
31. Enough of hand gel is being applied (3-5ml)	24	53	40	20	64	60,00 %	73	37,74 %
32. Hand gel is applied to dry hands	77	1	57	1	134	74,03 %	2	100,00 %
34. Correct drug	19	0	19	0	38	100,00 %	0	100,00 %
35. Correct dose	19	0	19	0	38	100,00 %	0	100,00 %
36. Gloves were used while preparation	18	2	14	5	32	77,78 %	7	40,00 %
37. Infusion set does not contain air after assembling	6	0	9	10	15	66,67 %	10	0%
38. Drug has not expired	19	0	19	0	38	100,00 %	0	100,00 %
39. Drug is stored correctly	19	0	19	0	38	100,00 %	0	100,00 %

40. Drug container perforated surface is cleaned with antiseptic agent before attaching transport cannula or infusion set	25	11	20	3	45	80,00 %	14	27,27 %
41. Residual infusion	0	0	1	0	1	0%	0	100,00 %
42. Drug container is marked according to local policy	19	0	19	0	38	100,00 %	0	100,00 %
43. Drug storage time before administration is appropriate according to instructions	19	0	19	0	38	100,00 %	0	100,00 %
44. Laminar airflow cabinet, apron	0	19	0	19	0	100,00 %	38	100,00 %
45. Laminar airflow cabinet respirator	0	19	0	19	0	100,00 %	38	100,00 %
46. Laminar airflow cabinet Sterile gloves	0	19	0	19	0	100,00 %	38	100,00 %
47. Laminar airflow cabinet Nursing cap	0	19	0	19	0	100,00 %	38	100,00 %
48. Laminar airflow cabinet Sterile drape	0	19	0	19	0	100,00 %	38	100,00 %
50. Use of old infusion set	13	6	15	4	28	86,67 %	10	66,67 %
51. If old set, is it aseptically preserved in stand	13	0	15	0	28	86,67 %	0	100,00 %
52. Patient identity is checked	4	15	2	17	6	50,00 %	32	88,24 %
53. Correct time (minutes from prescribed time)	11	3	16	3	27	68,75 %	6	100,00 %
54. Correct infusion drop rate	16	3	19	0	35	84,21 %	3	0%
55. Residual infusion	0	0	7	12	7	0%	12	0%
56. Rinse of infusion set	16	1	19	0	35	84,21 %	1	0%
58. Cannula is usable	27	0	19	0	46	70,37 %	0	100,00 %
59. Skin around cannula site is healthy	2	18	0	19	2	0%	37	94,74 %
	641	650	595	625	1236	92,82 %	1275	96,15 %