ORIGINAL ARTICLE

ADHERENCE TO MAJOR STANDARD PRECAUTIONS:
AN AUDIT OF VENEPUNCTURE AND INTRAVENOUS
CANNULA INSERTION IN THE PAEDIATRIC UNIT OF
HOSPITAL SULTANAH AMINAH, JOHOR BAHRU

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Abstract

Background: There are numerous guidelines regarding universal standard precautions that aim to reduce the risk of cross-infection and needle stick injury in procedures like venepuncture and intravenous cannulation. The success of these guidelines is dependent on the adherence of health personnel to their recommendations. Objective: To carry out an audit on the extent of pre-procedure preparation and adherence to standard precaution measures in venepuncture and intravenous cannulation in the Paediatric unit of a Malaysian tertiary hospital.

Study population and methods: A prospective clinical audit targeting personnel who performed venepuncture and/or intravenous cannulation in the Paediatric unit of a tertiary hospital in Johor, Malaysia. The audit took place between 22nd of March 2011 to 6th of May 2011. Results: There were a total of 91 procedures being observed during the audit period, including 69 venepunctures (75.8%) and 22 intravenous cannulations. The procedures were performed mainly by the doctors (90.1%). The lowest adherence rate to standard precaution was observed in the criterion of hand washing (20.9%), followed by hand gloving of the main and supporting hand (both 35.2 %), timely disposal of sharps (65.9 %) and preparation of post-procedure dressing or tape to secure the cannula in place (67.0 %). Conclusions: The rates of adherence to standard precautions were generally low during the performance of venepuncture and intravenous cannulation. A clear guideline on the steps of standard precaution should be made available in the procedure rooms to provide guidance during the performance of these procedures.

Keywords: Standard precaution; Venepuncture; Intravenous cannulation; Audit

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Introduction

Standard precautions in health care, developed and disseminated by the World Health Organization (WHO) cover a set of guidelines relating to the appropriate hygiene practice for health care workers who are in contact with patients. The adherence to the standard precaution measures is crucial in preventing the transmission of health care associated infections, for example blood-borne infections like HIV, hepatitis and other infections acquired through contact.1,2 Standard precautions are incorporated into the core curricula of health care disciplines in medical schools, either in clinical skills teaching or in dedicated modules such as patient safety. The awareness and practice of standard precautions are usually reinforced in health care institutions such as hospitals and clinics around the world, with adherence to standard precautions measures taken as a major indicator for the overall quality of service. We performed a preliminary prospective clinical audit in the Paediatric wards to evaluate the rates of adherence to the established criteria of standard precaution during venepuncture and intravenous cannulation using a proforma that we developed specifically for this project. The rationale for this audit was the increasing incidence of contaminated blood culture results among paediatric patients that delayed directed therapy, as well as the increasing incidence of needle stick injuries among the healthcare workers.

Methods

This is a preliminary project in the form of a prospective clinical audit conducted in the Paediatric unit of Hospital Sultanah Aminah, Johor Bahru, Malaysia. The audit took place between 22nd of March 2011 to 6th of May 2011. Our target personnel were the medical and nursing staff who performed venepuncture and/or intravenous cannulation. While the aim of venepuncture and cannulation was to achieve a full adherence (100%) to all standard precaution measures that were relevant to the procedures being performed, we set an expected standard of at least 90% to all measures for the purpose of this audit. The audit project was approved a part of the standard curricular requirements for final year students of Monash University Sunway Campus. It was also approved at the hospital and departmental level as part of the departmental quality improvement activities. As this was a preliminary audit project with a new dedicated proforma, and there was no personally identifiable information used, no direct contact with any human subject and no access to any clinical data throughout the audit, we did not obtain further ethics approval from the institutional or national review board.

During the audit period, students-researchers observed the procedures in the ward(s) that they were posted to in their final-year Paediatric posting. These observations were made predominantly during office hours between 8.00 a.m. to 5.00 p.m. during which their scheduled learning activities took place. We did not perform a sample size estimate as this was a preliminary study and there was no published studies that evaluated the same subject as a reference for our outcome estimates. We therefore employed convenience sampling method in which we observed any procedure performed by personnel who were on duty during the student researchers’ attachment period and timing. However, we performed a post-hoc power analysis using our available sample. Taking our expected audit standard of 90% compliance rate, our sample of 91 observations provided a power
of 0.9993 with a one-sided significance level of 0.05 (Stata 10).

Subjects of the audit were all health personnel who performed a venepuncture or intravenous cannulation in the Paediatric unit within the study period, from senior nursing staff to paediatricians. They were not differentiated based on their level of expertise or experience as we deemed that conformity to major standard precautions did not require any particular skill set or experience; only knowledge of these steps were essential. The target participants were unaware that they were being observed. We used a 15-item, anonymised proforma for the audit. The items in the proforma, taken from the published guidelines from the World Health Organisation (WHO) \(^1\)\(^-\)\(^3\), included general information (three items), steps in preparation (five items) and procedure (seven items). A detailed list of the items is provided in Figure 1. The data collectors discussed beforehand on what constituted an acceptable practice on each criterion listed in the proforma before commencing the audit. We completed one proforma for each procedure performed and collated the data into an electronic spreadsheet, through which we performed only standard descriptive statistics (Microsoft Excel version 2010).

**Figure 1. Criteria on standard precaution measures**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Yes (Tick) / No (Cross)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place observed</td>
<td></td>
</tr>
<tr>
<td>Venepuncture/IV cannulation</td>
<td></td>
</tr>
<tr>
<td>Who performed the procedure</td>
<td></td>
</tr>
<tr>
<td><strong>Preparation</strong></td>
<td></td>
</tr>
<tr>
<td>Needle/cannula</td>
<td></td>
</tr>
<tr>
<td>Alcohol wipe/cotton with alcohol</td>
<td></td>
</tr>
<tr>
<td>All required blood bottles</td>
<td></td>
</tr>
<tr>
<td>Cotton gauze to stop bleeding</td>
<td></td>
</tr>
<tr>
<td>Plaster/cotton with tape for post-procedure dressing OR tape to secure cannula in place</td>
<td></td>
</tr>
<tr>
<td><strong>Procedure</strong></td>
<td></td>
</tr>
<tr>
<td>Wash hands</td>
<td></td>
</tr>
<tr>
<td>Glove hands that holds needle/cannula</td>
<td></td>
</tr>
<tr>
<td>Glove supporting hand</td>
<td></td>
</tr>
<tr>
<td>Prepare and clean area of procedure</td>
<td></td>
</tr>
<tr>
<td>Not recapping needle ever during the procedure</td>
<td></td>
</tr>
<tr>
<td>Dispose of sharps to the sharps bin at the earliest possible time</td>
<td></td>
</tr>
<tr>
<td>Cleaning up spillage of blood or bodily fluids</td>
<td></td>
</tr>
</tbody>
</table>
Figure 1 shows the criteria on standard precaution measures during the preparation and performance of venepuncture or intravenous cannulation as listed our audit proforma. Data collectors were required to place a tick (“achieved”) or a cross (“not achieved”) in the allocated spaces that corresponded to each item in the proforma.

**Results**

We observed 91 procedures in total during the period of audit, including 69 venepunctures (75.8%) and 22 intravenous cannulations. Eighty two procedures (90.1%) were performed by doctors and the remaining eight by nurses. Each procedure was assessed using the full proforma except for 4 instances of IV cannulations as they were placed for purposes of IV medication or fluid therapy and did not require any blood bottles.

The adherence rates to the standard precaution measures ranged from 20.9% to 100%. There was only one item with 100% adherence rate, which is the preparation of needle and/or cannulae before the procedure (Figure 2). In general, adherence to standard precaution measures was higher in preparation than the actual performance of the procedures. For instance, in all but one item in the preparatory steps, the rates of adherence were 89% or higher (Figure 2), while during the actual performance of the procedures, only three out of seven items had adherence rates of higher than 90% (Figure 3). Overall, the lowest adherence rates were observed in hand washing (20.9 %), hand gloving of the main and supporting hand (both 35.2 %), timely disposal of sharps (65.9 %) and preparation of post-procedure dressing or tape to secure the cannula in place (67.0 %) (Figure 4).

**Figure 2. Pre-procedure preparation**

![Bar chart showing adherence rates for pre-procedure preparation](chart.png)

*Note: There were 4 samples where blood bottles were not required.*
Figure 3. Performance of procedure

![Histogram showing the performance of various procedures with percentages]

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wash hands</td>
<td>20.9 - 20.9</td>
</tr>
<tr>
<td>Glove main hand</td>
<td>35.2 - 35.2</td>
</tr>
<tr>
<td>Glove support hand</td>
<td>94.5 - 94.5</td>
</tr>
<tr>
<td>Clean area</td>
<td>65.9 - 65.9</td>
</tr>
<tr>
<td>No needle recap</td>
<td>93.4 - 93.4</td>
</tr>
</tbody>
</table>

Figure 4. Adherence rates of standard precaution measures

![Bar chart showing adherence rates of various precautions with percentages]

<table>
<thead>
<tr>
<th>Precaution</th>
<th>Adherence rates (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wash hands</td>
<td>100</td>
</tr>
<tr>
<td>Glove main hand</td>
<td>100</td>
</tr>
<tr>
<td>Glove support hand</td>
<td>100</td>
</tr>
<tr>
<td>Clean area</td>
<td>100</td>
</tr>
<tr>
<td>No needle recap</td>
<td>100</td>
</tr>
<tr>
<td>Early sharps disposal</td>
<td>100</td>
</tr>
<tr>
<td>Clean blood spills</td>
<td>100</td>
</tr>
</tbody>
</table>

Discussion

This audit shows that the rates of adherence to standard precaution measures were generally high during preparation but low during the actual performance of venepuncture and/or intravenous cannulation in the Paediatric unit in Hospital Sultanah Aminah, Johor Bahru, Malaysia. Notably, only one step out of twelve
evaluated had a full adherence rate. The findings raise concerns as the observed suboptimal compliance to standard precaution during the practical procedures could have contributed to hospital associated infections. On a separate note, the ratio of doctors performing the procedures compared with nurses was around 10:1. This was not intentional and only reflects the fact that these procedures were more frequently performed by doctors than nurses during the audit period. Furthermore, only senior nurses were allowed to perform these invasive procedures in the Paediatric unit, thus contributing to this ratio.

Nosocomial infection affects up to 26% of patients in intensive care units. Poor hand washing techniques has been attributed as the most important factor for spreading nosocomial infections in in-ward patients. Hand washing is strongly advocated in the WHO and Malaysian Ministry of Health guidelines for infection control while handling body fluids or gaining intravenous access. Compliance to handwashing guidelines, such as those published by Centers for Disease Control, can considerably reduce the rates of infection. However, healthcare workers’ compliance with such guidelines rarely exceeds 40% and this was considered to be among the biggest challenges in implementing standard precaution measures. The consequences of poor hand-hygiene practice have been well-documented. A case control study by Arvelo et al showed an association between cases of diarrhoea outbreaks and lack of hand washing. Similarly, a review by Todd et al stated that both enteric and respiratory diseases are easily spread where hand hygiene is not carried out effectively. Non-compliance to hand hygiene thus presents a major challenge for clinical governance as it is associated with prolonged hospital stays and consumption of scarce hospital resources. This is evidenced by a study using simulation models by Cummings et al which concluded that hand hygiene non-compliance is associated with significant hospital costs whereby substantial savings can be made by minimal improvements in compliance.

This study showed that hand washing and gloving and early sharps disposal were the three precaution measures with the highest rate of non-compliance. Although no formal survey of reasons for non-compliance of these steps were performed due to the need to maintain the anonymity of the audit, casual feedback found time constraints, measures deemed as unnecessary and may even affect procedure performance, and skin reaction to hand wash solutions as some reasons for non-compliance to hand washing and gloving. Besides that, young patients were generally uncooperative, especially during painful intravenous cannulation, thus a number of doctors quoted that it is more important to secure the cannula first before disposing the sharps due to the risk of a distressed child pulling the cannula out. In other studies, specific reasons for not washing hands at appropriate times include lack of knowledge of the risks of non-compliance to hand washing to the patients, a lack of motivation, time pressure, inadequate products or dispensers, lack of accountability, skin irritation and poor model role of chief-of-staff or senior physicians. In regards to non-compliance to hand gloving, a local study by Lee et al. found that reasons for it include being uncomfortable wearing gloves (14.1%), in a hurry (11.3%), unnecessary because patient was not a blood-borne pathogen carrier (4.2%), not being able to palpate the pulses (4.2%), lazy (1.4%), allergic to rubber gloves (1.4%), no available gloves and no gloves of suitable size (1.4%). These reasons are particularly important as just...
knowledge of standard precautions did not have a significant effect on reducing needle-stick injuries, rather it is the compliance during clinical practice.\textsuperscript{15,16} It was shown that even 84.2\% of healthcare workers with good or very good knowledge of standard precautions still had needle-stick injuries.\textsuperscript{17} Interestingly, although there is a significant difference in knowledge of standard precautions between a medical officer and a house officer (36.22 vs. 34.23, $P = 0.0001$)\textsuperscript{14}, there was no significant difference in the prevalence of needle-stick injuries with respect to the duration of clinical practice experience ($P = 0.69$) or mean working hours in the week.\textsuperscript{16,18} This trend was also observed among final year medical students of Malaysian medical universities who spent varying amounts of time performing such procedures; compliance to standard precaution protocol was the only factor shown to be significantly lower in students with needle-stick injuries ($P < 0.05$), and not the amount of time spent performing procedures.\textsuperscript{19}

As a change in behaviour after years of performing a procedure is difficult, early intervention during training is essential. An important aspect of intervention is education on recognizing situations where hand washing is important. Regular motivational campaigns at the workplace as well as standardized training programs are relevant additional measures. Training alone however is not sufficient for long-lasting improvement. Multiple-activity strategies must also include motivation of employees by use of peer pressure on noncompliant co-workers, a reward and/or penalty system.\textsuperscript{9,13} Role modelling has been shown to have a major influence in the practice of hand hygiene in an institution.\textsuperscript{13} According to a study by Creedon et al, implementation of a multifaceted interventional hand hygiene programme which included periodic practice audits and performance feedback as well as poster campaign and educational handouts resulted in an overall improvement in compliance with hand hygiene guidelines.\textsuperscript{8}

Since the AIDS epidemic outbreak in year 1987, hospital staffs have taken multitudinous steps to enhance infection control; amongst them is gloving. The usage of gloves in the United States has increased from 1.4 billion pairs in 1988 to 8.3 billion pairs in 1993.\textsuperscript{20} Due to the decrease in the incidence of transmission of this virus via this measure, gloves have been advocated to be the key to reduce transmission of other infections, either from the patients to the healthcare workers or vice versa and also cross infection where healthcare workers act as a vector to infections between patients.\textsuperscript{20,21} The effectiveness of this measure has been supported by Tenorio et al. This study reports a significant decrease in the number of vancomycin-resistant enterococcus species on the hands of gloved healthcare workers compared to non-gloved healthcare workers after examination of the infected patients.\textsuperscript{22} Coupled with the fact that up to 50\% of enterococcal infection in the paediatric age-group is fatal, gloving is an imperative measure.\textsuperscript{23} The Centers for Disease Control (CDC) study and Doebbeling et al study demonstrate consistent results with other pathogens.\textsuperscript{24} In terms of needle-stick injury and gloving, Collins et al has reported that gloving does not decrease the rate of needle-stick injury but it reduces the risk of transmission of blood-borne pathogens.\textsuperscript{25} This protects the healthcare workers from potentially fatal diseases that affect the paediatric age group. However, a study by Kinlin et al, which was conducted more recently, has shown that gloving also reduces the risk of needle-stick injury.\textsuperscript{26}
Proper handling of sharps consists of immediate disposal, or as soon as possible, into an approved container without recapping or handing off to another person. Timely disposal of sharps is important in an effort to prevent needlestick injuries.\(^{27}\) Suboptimal training and practicality may account for some reasons as to why proper sharp disposal regulations are not fulfilled.\(^{28}\) In particular, placing the sharps containers away from where IV lines are placed may have contributed to the non-compliance among health personnel. To reduce or eliminate the need for the health personnel to move through the immediate patient environment with unsheathed needles, multiple needle-disposal containers should be placed within reach of the point of use. A study published in the American Journal of Infection Control in 1994 found that installation of needle-disposal containers near patients’ beds has been found to decrease the reported number of needlestick injuries.\(^{29}\)

We acknowledge the following limitations in our audit. First, we did not examine the association of the observed practice to the clinical outcomes such as the rates of infection, hence we could not conclusively claim that the observed practice had major impacts on patient care in our particular setting. Besides, our sample was too small to enable a meaningful evaluation of each procedure separately. Next, we did not identify the personnel involved, and so we could not account for possible effects of the same person performing multiple procedures and meaningfully compare the performances of different staff categories. Additionally, we did not assess the performance if these procedures after office hours, during which the adherence to standard precautions might be different compared to that in the office hours.

**Conclusions**

There is room for improvement in the staff performance in the Paediatric unit with regards to their adherence to standard precaution measures when performing venepuncture or intravenous cannulation. A practical recommendation from this audit is to incorporate the WHO checklist for standard precaution measures, similar to our audit proforma, in the procedure rooms to provide a step-by-step guide to the personnel involved during the preparation and performance of venepuncture and/or intravenous cannulation, alongside continuing education on the importance of standard precaution measures with regular surveillance on hospital associated infections in the unit. A follow-up audit with a larger sample size that incorporates sufficient number of procedures performed by staff of different categories and at different timing should be performed to evaluate the change in practice following the implementation of the recommendations.

**Acknowledgement**

We would like to thank the staff of the Paediatric department of Hospital Sultanah Aminah, Johor Bahru for allowing us to conduct this audit at their premises, as well as the following people for contributing to data collection; Daniel SL Wong, Wen C Gan, Nai C Huan, Hui M Lee, Nadia Rajabalee, Maz H Mohd Arshad and David CW Lan.

**Conflict of interests**

The authors declare no conflict of interests.

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