



# Measured and perceived handover effectiveness among nurse, paramedic and medical students

Amanda Hlushak <sup>1</sup>, Alexander MacQuarrie <sup>1</sup>,  
Clare Sutton<sup>1</sup>, Georgina Pickering<sup>1</sup>, Patricia Logan<sup>1</sup>  
and Caroline Robertson <sup>2</sup>

## Abstract

**Objective:** This study aimed to measure the effectiveness of student handovers in simulation and examine perceptions of handover effectiveness.

**Methods:** A mixed-methods crossover study involving inter-professional teams of nursing students (NS), paramedic students (PS) and medical students (MS). Students participated in two medical clinical simulations, which involved handovers, completion of self-reflection questionnaires (SRQ) and pre-post simulation questionnaires: Readiness for Interprofessional Learning Scale (RIPLS) and Attitudes Towards Health Care Teams Scale (ATHCT).

**Results:** 18 handovers were observed. Outbound simulation (n=9): 61% of all data items were transferred by the MS, 60% by NS, and 63% by PS. Inbound simulation (n=9): 80% of all data items were transferred by PS, 64% by NS and 50% by MS. Information handed over was most variable when broken down into categories. Data most likely to be handed over were patient demographics, clinical impression and treatment. Least likely to be handed over were additional background and response to treatment. The RIPLS questionnaire showed significant differences between student groups and a change in score between pre-post questionnaires, with NS and PS scoring higher than MS:  $6.33 \pm 3.51$ ,  $4.71 \pm 4.37$  and  $-2.67 \pm 2.3$ , respectively ( $p < 0.05$ ). No differences were noted between the pre- and post-ATHCT questionnaire. Comparison of actual and perceived data transferred showed the percentage of non-clinical data actually transferred to be higher than students' perceived ( $p < 0.05$ ).

**Conclusion:** In simulation, a significant amount of critical patient information was lost in subsequent handovers. The greatest loss of data occurred from additional background information and response to treatment. There was also an imbalance between students' perceptions of, and actual, data transferred. Our results indicate that students require increased opportunities for handover practice and clarification on what constitutes an accurate handover. Amalgamation of current handover tools to a single tool that can be used in pre-hospital and hospital environments may be beneficial.

**Keywords:** simulation, handover, undergraduate, interprofessional education

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<sup>1</sup> Charles Sturt University, Bathurst, Australia

<sup>2</sup> Western Sydney University, Bathurst, Australia

**Corresponding author:** Amanda Hlushak, Research Station Drive, Bathurst 2795 [amanda.hlushak@gmail.com](mailto:amanda.hlushak@gmail.com)

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## INTRODUCTION

Clinical handover, used to concisely relay patient information during transfer from one professional to another (Yu & Kang 2017), is a vital skill to understand and employ in the delivery of patient care (Wood et al. 2015). It demands an understanding of patient condition to enable communication to other care providers, while ensuring patient-specific material is delivered, received and encoded (Jeffcott et al. 2009). To contribute to optimal patient outcomes, the most pertinent material should be delivered promptly (Abraham, Kannampallil & Patel 2014; Foronda, MacWilliams & McArthur 2016).

While research exists on different handover tools, especially in nursing and paramedicine, there is no standardised tool used between nurses, paramedics and doctors (Patterson & Wears 2010). The tools used are generally facility specific, such as SBAR: situation, background, assessment, recommendation, which is used predominantly in hospitals; and IMIST: identification, mechanism, injuries, signs/symptoms and treatment, predominately used in the pre-hospital environment (Bost et al. 2012; Gordon and Findley 2011; Jeffcott et al. 2009; Merten, Van Galen & Wagner 2017). This lack of a standardised tool impacts handover effectiveness and patient care (Evans et al. 2010; Ye et al. 2007). Additionally, it has been identified that professional, social, environmental and human factors, beyond handover structure, influence its effectiveness (Wood et al. 2015). Unsurprisingly, during multiple interdisciplinary handovers, loss of information is well recognised (Evans et al. 2010). This is likely to be compounded by the fact that disciplines learn and work independently, existing as their own 'tribes' (Weller 2012) and ultimately contributing to breakdowns in communication and patient care outcomes (Foronda, MacWilliams & McArthur 2016).

Barriers to handover effectiveness may be overcome by increased interprofessional education (IPE). IPE is known to be an important process that assists in role identification, differentiating scope of practice, and understanding differences in professional languages (Stow et al. 2017). There have been various calls for increased IPE in student populations to enable them, as graduates, to work more effectively in a clinical environment (Tunstall-Pedoe, Rink & Hilton 2003). However, there is little research available examining IPE effectiveness in student populations. Simulation is a useful medium for

promotion of IPE as it offers opportunities for health care professionals to work together in a clinically safe environment and to experience the value of other disciplines (Angelini, 2011), whilst providing opportunities for shared learning. Consequently, it is being increasingly used as a medium for collaborative practice and for building cohesion in the team environment (Angelini 2011; Furseth, Taylor & Kim 2016; Havrilla-Smithburger, Kane-Gill & Seybert 2012).

Training together is important for health professionals, but something done infrequently with health students at the undergraduate level. Increasing the opportunity for IPE in this population may help to improve the skills required for providing effective handovers. There is limited research examining IPE and handover effectiveness between students, specifically nursing (NS), paramedic (PS) and medical students (MS). Such research may help to improve understanding of the current status of undergraduate handover skill level. The aims of this study were, therefore, to measure how effectively undergraduate medical, nursing and paramedical students give and receive handover information and to measure student perceptions of their own handover effectiveness.

## **METHODS**

### **PARTICIPANTS AND ETHICAL APPROVAL**

Fourth-year undergraduate MS ( $n=4$ ) from Western Sydney University (WSU), first-year undergraduate NS ( $n=3$ ) and third-year undergraduate PS ( $n=8$ ) from Charles Sturt University (CSU) participated. Third-year nursing students were targeted to participate, but were unavailable, and so first-year students were recruited. Students were recruited based on their being an undergraduate student of the nominated year within the required discipline. They also had to be from the nominated universities to ensure that the scenarios were of an appropriate scope of practice. Ethical approval was obtained from the CSU Human Research Ethics Committee (H17162) and reciprocally from WSU Human Ethics Committee (RH12439). Informed written consent was obtained from all participants.

### **STUDY DESIGN**

Using a mixed-method, crossover design, students participated in a clinical simulation day held at the high-fidelity simulation centre at CSU. Student names were randomly drawn and assigned to multidisciplinary (PS [ $n=2$ ], NS [ $n=1$ ], MS [ $n=1-2$ ]) teams ( $n = 4-5$ ), which performed two clinical simulations: outbound and inbound, These were video recorded for analysis. Crossover occurred whereby both paramedic and medical students acted as the handover provider and receiver, crossing between the inbound and outbound scenarios. Two validated questionnaires were administered pre and post simulation to examine participant's attitudes towards health care teams (ATHCT) and their readiness for interprofessional learning (RIPLS) (Kim & Ko 2014; Reid et al. 2006). Additionally, following delivery of the first handover, within both the inbound and outbound scenarios (as described below),

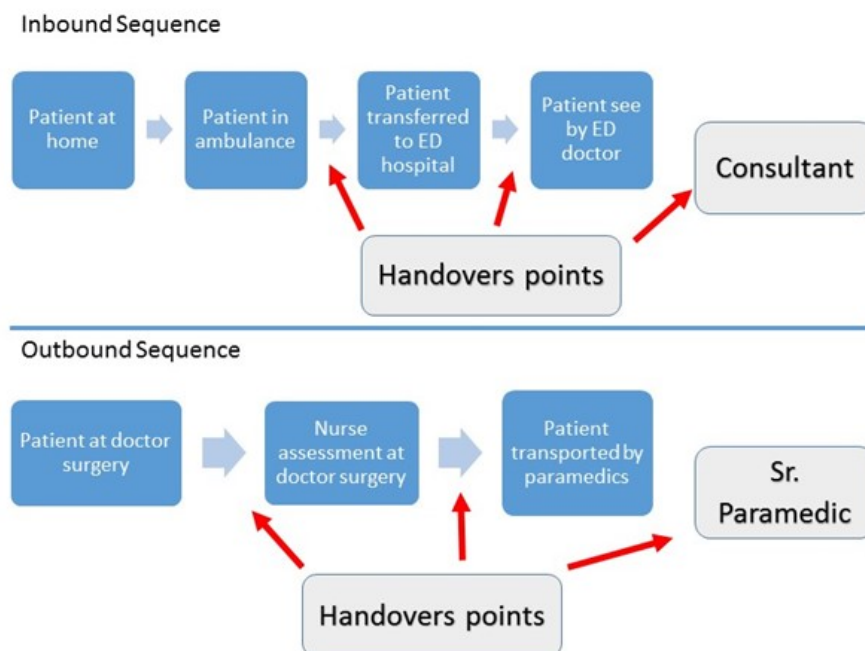
the respective student (PS or MS) completed a self-reflective questionnaire (SRQ) examining their learnings about handover.

## SCENARIOS

Scenarios were created using the Emergency Medicine Simulation Workbook (Thoureen & Scott 2013). The scenarios were adapted to fit the location, scope of practice, and equipment available. Scenarios were designed for optimal intergroup cooperation, aiming to maintain equal group status, common goals and ascertaining a collaborative approach using Allport's theory (Bridges & Tomkowiak 2010). Final scenarios were agreed upon by all discipline educators. The disciplines included: nursing, paramedic, and medical educators. Participants were briefed on the simulations and equipment and familiarisation was undertaken prior to beginning the scenarios.

## INBOUND

A patient with asthma was assessed by the inbound PS team at home. The PS transferred their patient to an ambulance for a simulated transfer time (20 min.) handing over the patient to the NS at the emergency department (ED). The NS completed an assessment (20 min.) before handing over to the MS who completed their assessment (20 min.) before final handover via phone to a medical consultant (Figure 1). Following the PS handover to the NS, as previously described, the PS completed the SRQ.



**Figure 1:** Handover sequence for inbound and outbound simulations

## OUTBOUND

A patient with query sepsis was assessed at a doctor's surgery by the MS (20 min.). The patient's presentation required transfer to hospital. The MS was then called to the waiting room for another collapsed patient (decoy) enabling the NS who received the initial handover to continue the patient assessment (20 min.). The PS crew arrived for transport, moving the patient to the ambulance (20 min.) simulating the transport period before final handover to a senior paramedic (Figure 1). Following the MS handover to the NS, as previously described, the MS completed the SRQ.

## DATA COLLECTION

### QUESTIONNAIRES

The ATHCT questionnaire was used to examine general attitudes towards interprofessional health care teams. Students scored 21 statements on a 6-point Likert scale (1–strongly disagree, 6–strongly agree). The RIPLS questionnaire was used to examine readiness for interprofessional learning, with 19 statements scored on a 5-point Likert scale (1–strongly disagree, 5–strongly agree).

### HANDOVERS

The two scenarios (inbound and outbound) were run three times. Within each scenario there were three handovers, giving a total of nine inbound and nine outbound handovers completed (total  $n=18$ ). These were recorded using a handheld camera.

### REFLECTIVE QUESTIONNAIRES

Student reflective data were collected by the completion of an SRQ containing five visual analogue scales (VAS) (Okitsu et al. 2014) and two open-ended questions. The VAS was scored on a 10 cm long line and asked about handover effectiveness, amount of clinical and non-clinical data points transferred. The open-ended questions required students to watch the second handover (live) in the control room of the simulation centre on the built-in video recording system, and then respond to the following questions: 'What do you think was effective about the handover and why?' and 'What did you learn by watching?'

### HANDOVER CHECKLIST

To our knowledge, no generalised validated handover checklist tools currently exist. Therefore, a handover checklist was created using the information presented in the scenarios, which resulted in seven categories, following a similar structure to the handover tools IMIST and SBAR. Categories were: Identification, Background, Additional Background (non-clinical), Clinical Impression, Medical Information, Treatment, and Response to Treatment (clinical). Two clinical academics (a paramedic and a nurse) independently developed a handover checklist of categories and content based on the scenarios. Whilst it was not validated, this checklist was compared to the lead investigators' handover checklist and found to be identical.

## DATA ANALYSIS

### HANDOVERS

The total handover score (%) was calculated based on data available to the relevant student. If some data points from the checklist were not transferred from one student to another during the handover, this was taken into account and the student delivering the handover was not scored lower for missed information. For example, if a student did not perform a 12-lead and therefore did not pass the ECG information onwards, no loss was recorded on their handover checklist score. Students did not have points deducted if they did not have the information to pass on. Data points transferred were scored by review of the video footage against the inbound and outbound checklists. This process was performed independently by two experienced clinicians, both with more than five years of clinical practice and a minimum of three years' academic experience. Inter-rater reliability was assessed by intraclass correlation coefficient with raters showing moderate agreement with an  $r$  value of 0.73 ( $p = 0.002$ ) (Koo & Li 2016).

### RIPLS AND ATHCT QUESTIONNAIRES

The questionnaire Likert responses were scored and summed for a total score. Pre- and post-test differences were calculated for each participant.

### REFLECTIVE QUESTIONNAIRES

The SRQs were scored as percentages of the VAS anchor points from 0–100%. The open-ended question responses were analysed using manifest content analysis.

### STATISTICAL ANALYSIS

Continuous data were inspected for normality and model assumptions checked prior to analysis. RIPLS and ATHCT data were analysed as changes from pre to post using a weighted least-squares ANOVA. Handover, data were analysed as changes between and within clinicians, time (inbound/outbound) and information lost using ANOVA. Following significance in ANOVAs, pairwise differences were identified using Tukey's HSD post-hoc test. Interrater reliability was calculated using Cronbach's alpha coefficient. All data were analysed using the Statistical Package for the Social Sciences (SPSS version 24, IBM) with significance set at  $p < 0.05$ . Results are presented as mean  $\pm$  SD or confidence intervals (CI) where appropriate.

## RESULTS

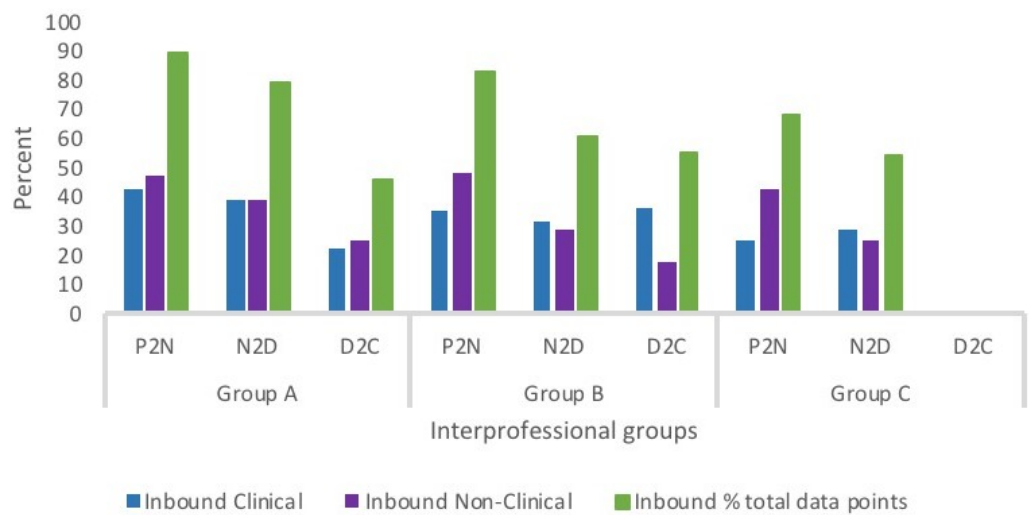
### HANDOVER DATA TRANSFER

During the outbound clinical simulation, 61% of all data items were transferred by the MS, 60% by the NS, and 63% by the PS (Figure 2a).

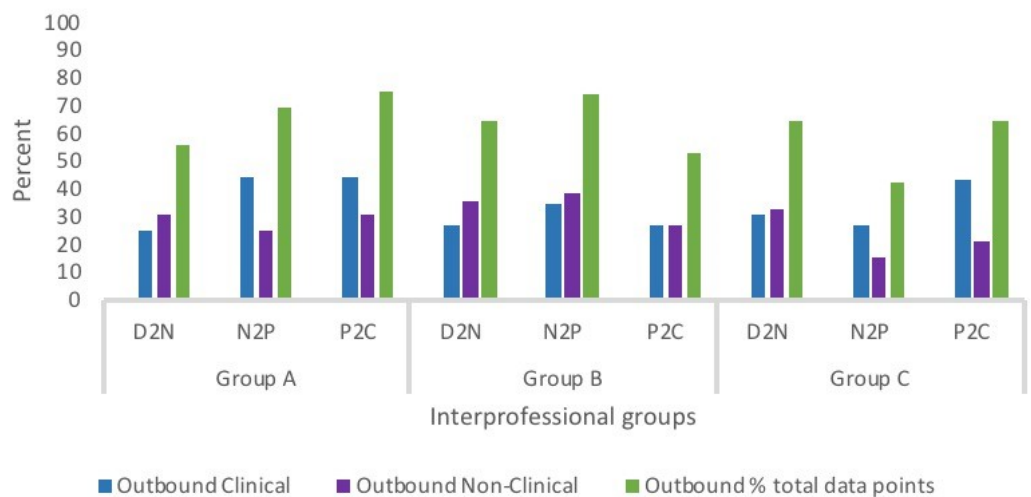
During the inbound clinical simulation, 80% of all data items were transferred by the PS, 64% by the NS and 50% by the MS (Figure 2b).

Equal amounts of data were transferred in both inbound and outbound scenarios. There was also no difference in handover performance for each student group comparing inbound and outbound scenarios. Comparisons of handover were significantly different between the mean score for MS to consultant handover (D2C) ( $48.5 \pm 8.5$ ) and the PS to NS handover (P2N) ( $79.3 \pm 7.1$ ) ( $p = 0.001$ ). Handovers between NS to PS (N2P) and NS to MS (N2D) demonstrated no significant difference. There were significant interactions between the percentage of complete total data points handed over and the information delivered when broken down by categories (Table 1).

(a) Inbound handover



(b) Outbound handover



**Figure 2.** Percentage of clinical and non-clinical data points handed over within professions, between groups: (a) inbound and (b) outbound scenarios.

**Table 1: Total of all completed handover points (%) of each clinical and non-clinical data set**

	Information	Means $\pm$ SD	Post hoc
Non-clinical	Identification	92.65 $\pm$ 17.56	1 > 2,3,6*
	Additional Background	49.41 $\pm$ 17.56	2 < 4,1,5*
	Medical Information	57.65 $\pm$ 24.87	3 < 1,4*
Clinical	Clinical Impression	70.75 $\pm$ 17.56	4 > 2,6*
	Treatment	77.21 $\pm$ 20.41	5 > 2,6*
	Response to Treatment	38.43 $\pm$ 29.86	6 < 1,6*

\* $p < 0.05$ **REFLECTIVE QUESTIONNAIRES**

Analysis of the SRQs, showed the actual non-clinical data transferred to be higher than the perceived non-clinical data transferred by  $36.5 \pm 26\%$  ( $p=0.019$ ) (see Table 2). There was no difference between actual and perceived clinical data transferred (see Table 2).

**Table 2: Mean difference between actual and perceived handovers of clinical and non-clinical data points**

	Clinical		Non-clinical	
	Actual (%) A	Perceived (%) P	Actual (%) A	Perceived (%) P
D	55	78	72	43
P	68	73	93	50
<b>Mean diff (A - P)</b>	13.83 $\pm$ 19.6		-36.5 $\pm$ 26.03 $p = 0.019$	

**OPEN ENDED REFLECTIVE QUESTIONS**

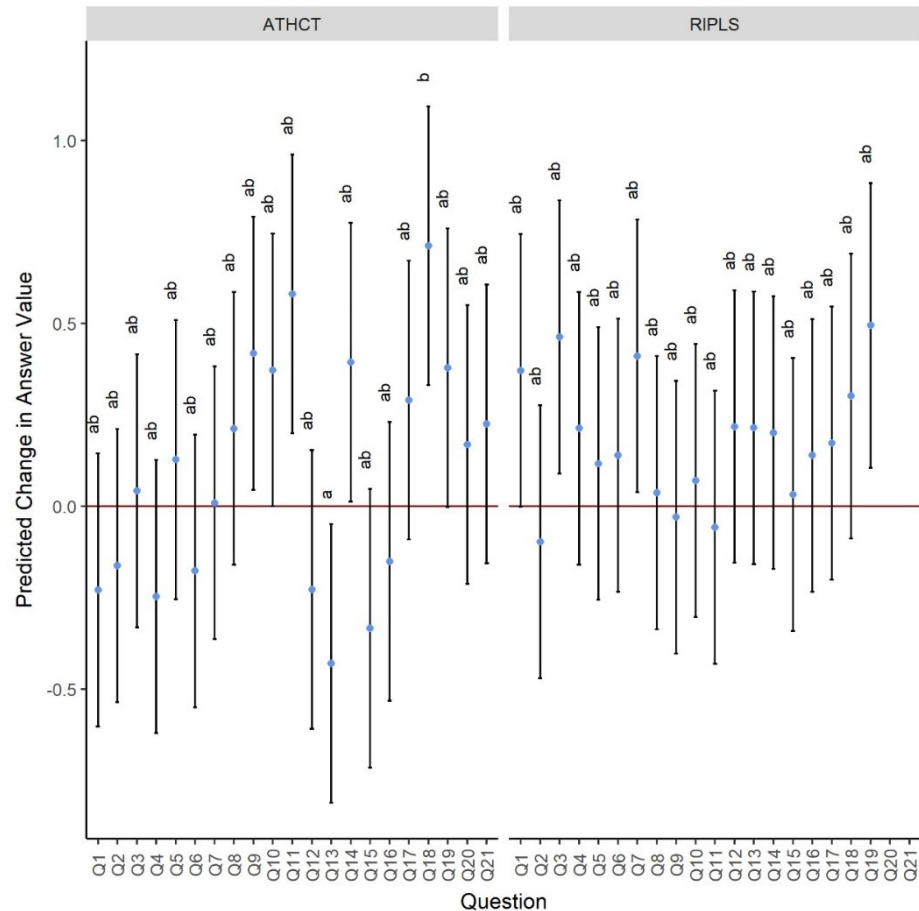
Responses to both questions were combined due to the similarity in learnings. Analysis showed students felt the following were important in an effective handover: notes and writing 67%; systematic, structured and detailed approach 50%; clear and succinct information 50%; closed-loop communication 67%; and addition of new patient assessment information 50% ( $n=6$ ).

**ATHCT**

Overall pre-post ATHCT scores were not different between professionals ( $p > 0.05$ ). However, within questions, 13 and 18 demonstrated statistical significance. There was a negative change in 13: 'Should physicians have the final word in decision making made by health care teams'; and a positive change in 18: 'In my opinion, physicians are natural team leaders'. Significant positive changes ( $p < 0.05$ ) were evident for questions 9, 11 and 14 (Figure 3): 'In my opinion developing a patient care plan with other team members avoids errors in delivering care'; 'Health professionals working on teams are more



responsive than others to the emotional and financial needs of patients'; and 'The give and take among team members help them to make better patient care decisions'.



**Figure 3:** Post-hoc analysis of main interactions between predicted change in answer pre and post for ATHCT and RIPLS questionnaires

### RIPLS

There was a difference between professionals ( $p < 0.05$ ) in pre-post questionnaires. Nurses ( $6.33 \pm 3.51$ ) and paramedics ( $4.71 \pm 4.37$ ) were significantly higher than doctors ( $-2.67 \pm 2.3$ ) in post-hoc comparison. There were no significant differences between the nurses and paramedics (Figure 3).

There were no significant differences between questions, however three questions, 3, 7, and 19, had positive changes in predicted answer value (see Figure 3): 'Shared learning with other health and social care students/professionals will increase my ability to understand clinical problems'; 'Learning between health care students before qualification would improve working relationships after collaborative practice'; 'I have to acquire much more knowledge and skill than other students in my own faculty'.

## DISCUSSION

The aims of this study were to measure handover effectiveness and perceptions of handover effectiveness among medical, nursing and paramedic students. The results demonstrate several important findings. With regards to effectiveness, there was an increase in information lost across multidisciplinary handovers. Students showed a poor awareness of patient assessment, with the most frequently lost data being from additional background and response to treatment. Furthermore, the students' own perceptions of handover performance did not match their actual performance.

### INFORMATION LOST ACROSS HANDOVERS

Medical error(s) associated with handovers is a well-known phenomenon (Starmer et al. 2014) and has been demonstrated in this study. Transfer of information across disciplines resulted in loss of data. Previously noted challenges to successful handovers are: the ability to perform a cognitively demanding task in a limited time period, lack of note taking, and reliance on memory, and inconsistent use of mnemonics (Fitzpatrick et al. 2018). These challenges may explain our results. Similar findings were reported in this study by the student reflections, with note taking and use of a systematic/structured approach highlighted as being effective in reducing such information loss and achieving successful handovers.

Within an educational, rather than clinical, setting more patient assessment education may be required to better facilitate accurate handovers (Ye et al. 2007; Yong, Dent & Weiland 2008). Whilst a lack of handover education and experience may have played a role in the ability to convey or perform a patient assessment, it was noted in the student reflections that using closed-loop communication was important for handover effectiveness. This closed loop communication would assist in clarification of the message, which would help to remove assumptions about patient data and therefore ensure a better handover. Information synthesis by receiver has previously been suggested as a method that can reduce medial errors in handovers (Starmer & Landrigan 2015); however, it is yet to be integrated within more well-known acronyms. This technique would also be important with disciplines using different medical language.

### KNOWLEDGE OF HANDOVER CONTENTS

When the seven handover categories were examined, all three student disciplines were effective at handing over patient demographic information, observations and treatments. However, there was a significant loss of information from additional background and response to treatment. This highlights specific non-clinical and clinical data omitted from handovers, which has the potential to cause catastrophic medical errors impacting on patient outcomes. This may represent the lack of use of a structured system or common mnemonic across the student groups, and/or that students are not yet fully aware of the key constituents required for a successful handover. This latter point is supported by the difference between students' actual non-clinical and perceived non-clinical data transferred,

highlighting a discrepancy in their knowledge base about what may form non-clinical data. This underlines important considerations for education: a lack of expertise and consequent misunderstanding of the clinical and non-clinical context of both the patient and the content required in a handover can, potentially influence the amount of information transferred (Thakore & Morrison 2001).

When examining the data lost from 'additional background' and 'response to treatment' it is apparent that, in comparison to familiar handover tools used in the prehospital and hospital environments (IMIST and SBAR), the categories are not clearly discernible. Despite background in the second half of IMIST-AMBO, there was discordance between what information should be included (the checklist) and what students thought they handed over. This suggests a misunderstanding by students of the current tools, with the need to enhance education on handover content. This may be mitigated by designing a single handover tool that incorporates these handover categories. The previously created tool I-PASS (illness severity, patient summary, action list, situation awareness and contingency plans, and synthesis by receiver) (Starmer et al. 2014) may help to address some of these issues, but this tool does not yet appear to have made it into the health care domain worldwide, nor into education.

## **HANDOVER APPROACHES**

In the videos, the nurses took a more thorough and standardised approach to handover than the other disciplines. Their approach utilised written notes and a standard adult general observation chart (SAGO). Nurses learn in first year to use documentation to support their patient assessments, which may account for their handover effectiveness (Drach-Zahavy, Goldblatt & Maizel 2015). Interestingly, written documentation was identified by the student paramedics and doctors in their reflections as a tool that should be used for handover success. Disparity across student disciplines in handover knowledge and ability, particularly amongst final-year students who are close to practicing in a clinical environment, indicates that students require better educational practices to enable skill development for real-world practice, where handovers are a key aspect of patient care.

## **INTERPROFESSIONAL EDUCATION IN STUDENTS**

Nurses and paramedics showed a positive change in their readiness for interprofessional learning (RIPLS), however no change was observed for the doctors in either questionnaire (ATHCT/RIPLS). Previous work examining attitudes and readiness for IPE in students has shown that year of study may influence these parameters (Maharajan et al. 2017). Since the medical students had one or two more years of study than the nurse or paramedic students, this may have influenced these scores. Additionally, changes in attitudes of some students following IPE have been shown to be less variable in medical students compared to other health care students (Tunstall-Pedoe, Rink & Hilton 2003) and may highlight preconceptions of one profession towards another (Tunstall-Pedoe, Rink & Hilton 2003). Similar findings were shown in our study with changes in the following statements: 'Should physicians have the final word in decision making made by health care teams'

(negative change); and, 'In my opinion, physicians are natural team leaders' (positive change). Finally, the positive changes in responses seen from both questionnaires included positive group interactions, improving individual skills, and working towards a holistic patient care model for positive patient health outcomes. IPE therefore appears to be an effective tool to improve collaborative health care practice.

According to Allport's theory, positive IPE experiences are achieved when participants in different professional groups, such as different health disciplines (nursing, paramedic, medical), have an equal level of education and scope of practice, usually from the same year of study (Bridges & Tomkowiak 2010; Gierman-Riblon & Salloway 2013). This collaborative paradigm seeks to improve patient outcomes by increasing the respect and positive attitudes of students involved in interprofessional education by removing potential confusion when trying to work collaboratively with another health discipline in a higher or lower level of study. Although from a different student year group, the ability of the nursing students to handover information was not affected, with no difference in data transfer compared to paramedic and medical students. Whilst their ability to interpret some medical information may have been impaired, this highlighted to other students the importance of clear communication during handovers, including understanding students' scope of practice. This data shows there is merit in introducing IPE in earlier years of undergraduate programs.

## **LIMITATIONS**

The current study had a number of limitations. First, the sample size was small and so results need to be interpreted with caution. Simulation realism can impact participant performance (Berkenstadt et al. 2008); however, based on student performance, we suggest the simulations were authentic, supporting an appropriate and immersive environment. A cross-over design for scenarios was used to minimise learning effect.

Additionally, given the simulations were videoed, there was potential for the Hawthorne effect to influence student performance. No difference was found between scenarios, therefore this is deemed not to have been an issue.

Finally, we acknowledge the use of first-year undergraduate nursing students does not align with Allport's theory of IPE, and using some less experienced students may have affected our results. However, many important observations were made as a result of using first-year students, and further research is needed.

## **CONCLUSION**

To our knowledge this is the first study looking at the current status of handover performance and perceptions of handover effectiveness with student doctors, nurses and paramedics. Student reflections identified key learnings from undertaking handovers and from multidiscipline teamwork. Whilst more evidence is required, this study goes some way towards indicating that students benefit from IPE as early as in their first year of study. Deficiencies in current handover tools were identified, indicating that some aspects are poorly defined. These

results, in conjunction with existing literature, highlight the importance of developing a tool that promotes a gold standard in handover that is universally understood and supported in undergraduate education.

### **Acknowledgements**

The authors sincerely thank the academics for their participation on the simulation day. They are grateful for the assistance of the CSU academics, Paul Mahoney and Renee McGill, and CSU laboratory staff, Keira Ussher, Jason Poposki, and Sarah Strutt. We would also like to thank Dr. Kam Wong and Dr. Ross Wilson of Western Sydney University for their participation on the day. Thank you to Dr. Janine Bailey, Karen Beattie and Jane Thompson from Western Sydney University for their collaboration on the project. We would also like to thank Sharon Nielsen for assistance with the statistical analysis. Thank you to all the students who participated in the simulations and consented to be a part of this research study.

### **Conflicts of interest**

The authors declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

### **Funding**

No funding was received for this project.

### **Authors' contributions**

Amanda Hlushak was responsible for the literature review, data collection and analysis and is the primary author of this manuscript. Caroline Robertson contributed to the study design, data collection and data analysis. Clare Sutton and Georgina Pickering designed the scenarios, undertook data collection and manuscript preparation. Alex (Sandy) MacQuarrie contributed to the study design, data collection, analysis and manuscript preparation. Patricia Logan assisted with data analysis and undertook key revisions to the manuscript.

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