Title: **A scoping review of clinical handover mnemonic devices**

Amos Yung[1]*, Chi Shing Pak, MBBS[2], Bernadette Watson[1]

[1]International Research Centre for the Advancement of Health Communication

Department of English and Communication

The Hong Kong Polytechnic University

[2]Accident & Emergency Department,

Queen Elizabeth Hospital,

30 Gascoigne Road, Kowloon, Hong Kong.

*Contact: amos.yung@connect.polyu.hk

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Abstract

Background: Since the Institute of Medicine (IOM) published *To Err is Human: Building a Safer Health System* in 1999 [1], clinical handovers (or handoffs) and their relationship with the communication of patient safety have raised concerns from the public, regulatory bodies and medical practitioners [2, 3]. Protocols, guidelines, forms and mnemonic devices have been created to ensure safer clinical handovers. An initial literature search did not find a framework to describe the clinical processes and functions of each mnemonic device and its elements. The absence of a systematic framework could hinder the study across and the reusability of the established clinical handover mnemonic devices. This study aims to develop a universal framework to describe the clinical processes and functions essential to patient safety during handover.

Methods: We queried PubMed.gov and obtained 98 articles related to clinical handovers. We examined the citing sources of the mnemonics mentioned in these articles. A total of 42 handover mnemonics with 238 elements were identified. Our review noted that there was no taxonomy to describe the clinical functions and process associated with the clinical handover mnemonic devices. We used grounded theory to address this gap and built a new taxonomy from the 42 mnemonics. A researcher read all mnemonics, developed a taxonomy for tagging clinical handover mnemonics and categorised all mnemonic elements into correct processes and functions. After that, the second researcher, a medical practitioner, examined the taxonomy and made suggested corrections for the labelled functions of all mnemonic elements. Both researchers agreed on the taxonomy and the labelled processes and functions of different mnemonic elements.

Results: The taxonomy contains three processes and twenty functions in clinical handovers. Clinical processes like *medical condition*, *medical history, medical evaluation, care plan, outstanding care/tasks/results*, and *patient information,* as an administrative process, were widely adopted in clinical handover mnemonics. Moreover, mnemonic elements on communication manner and information validation had been identified in the list of clinical handover mnemonics

Conclusion: Although we recognise challenges because of both the vast number of clinical handover scenarios and the task of placing them under a few predefined groups, our findings suggest that such a taxonomy, as developed for this study, could assist medical practitioners to devise a clinical handover mnemonic to best fit their workplace.

Keywords: mnemonics, patient safety, handover, hand-off, sign-out

A scoping review of mnemonic devices for clinical handover

Introduction

Mnemonics assist individuals to remember specific words or a list. They categorise the information into small chunks. For example, the mnemonic device SOAP takes the first letter of the four elements: Subjective (evaluation), Objective (evaluation), Assessment (from these evaluations) and Plan (which concludes the assessment) [4]. Doctors and nurses use the mnemonic SOAP to ensure all relevant information is included when conducting a patient assessment and writing up patient clinical notes [4-6].

Many positively reported clinical handover mnemonic devices were found in the literature (e.g., ISBAR, VITAL, etc.). Those mnemonics represent frequently used key elements in clinical handovers. A few mnemonics, such as ISOBAR and SBAR, were prompted by regulatory bodies and professional organisations aiming to improve and standardise clinical handover processes (e.g. Australian Commission on Safety and Quality in Health Care [7]). However, there was a lack of evidence-based research to support the effectiveness of mnemonics in clinical handover [8], and we found many new clinical handover mnemonics were reported from time to time, which may suggest the reusability of developed mnemonic devices is low. Furthermore, teaching clinical handover could be challenging when there is no overarching framework to examine the growing number of mnemonics.

Since clinical handover mnemonics reported in the literature contain important handover elements in clinical settings, this study aims to explore the taxonomy behind clinical

handover mnemonics and identify the clinical functions and processes attached to these devices. With this accessible taxonomy of clinical handover, researchers, hospital and clinic managers, and practitioners could collaboratively design a clinical handover system that meets their generic needs by evaluating similar functions in an existing repository of clinical handover mnemonics. This study was part of an ongoing Emergency Department clinical handover research project.

Methods

Terminology

Our terminology replicates terms from the current literature on hospital emergency departments and shift handovers/handoffs. Handover is the common term in the UK and other countries, while handoff is more common in the USA. The emergency department (ED) was specified in the query because ED manages many aspects of patient care beyond patient treatment, including discharge, admission, and medication [59]. The four-hour service pledge compresses the ever-changing population of patients that ED physicians and nurses face [60]. Furthermore, ED manages patient handover to many units and specialities within and sometimes outside their hospital. The high turnover rate and dynamic ED operation often push the boundaries of patient handover safety to its limits [61, 62].

Information sources

PubMed was used for collecting literature related to the study. PubMed indexes over 30 million citations from MEDLINE, as well as PubMed Central, MeSH, ClinicalTrial.gov and other related databases.

Inclusion and exclusion criteria

We concentrated on mnemonics used in shift handover and so research not related to the use of mnemonics and other mnemonics used in other contexts such as post-operative procedures were not included. To understand how these mnemonics are related to clinical handover, we used Google Search to find earlier materials that introduced the mnemonic device cited by the article writer.

Search procedures

The following terms were used to query PubMed database:

> ("shift handover" emergency department) OR ("Emergency Service, Hospital/organization and administration"[MeSH] handover) OR ("shift handoff" emergency department).

After collecting articles listed in the query result, the first author (AY) read each paper and identified articles that fulfil the inclusion criteria set forth in this study.

Data analysis

The first author collected all mnemonics related to clinical handover and their definitions from the included articles. After that, the first author searched for the original definitions

from the references reported by the article writers and included those in the analysis of each mnemonic. The first author analysed all collected mnemonic definitions and summarized their clinical functions. The second author, who is an ED physician, reviewed all collected evidence and the analysis results, and corrected inaccurate descriptions. The first author and the second author discussed and agreed upon the results reported in this study.

Quality of the evidence

PubMed is a search engine for accessing literature from MEDLINE which is the disseminator of highly rated biomedical literature. MeSH subject heading was employed to include literature related to emergency service and hospital management and administration.

Results

We queried PubMed with the above command on 15 February 2022 and obtained the 98 articles. Among the 98 articles we collected, the authors of 14 of these had reviewed or shared their success in using clinical handover mnemonics in workplaces. We read these 14 articles and collected all clinical handover mnemonics cited in these articles. This method expanded the scope of relevant clinical handover mnemonics within and outside the ED environment and brought us 42 mnemonics in total (Table 1). See Figure 1 PRISMA diagram.

Study characteristics

Our review noted that there was no taxonomy to describe the clinical functions and process associated with the clinical handover mnemonic devices. We used grounded theory to address

this gap and built a new taxonomy from the 42 mnemonics. To develop a comprehensive taxonomy, a researcher tagged all 238 mnemonic elements and grouped them into twenty functions of three processes (Table 2). The second author (CP), a medical practitioner, then read the taxonomy and updated the labelled functions of all mnemonic elements if he identified any label assigned as inaccurate. Both the first and second authors agreed on the taxonomy and the labelled processes and functions of all mnemonic elements.

The taxonomy included *administrative*, *clinical*, and *communication* processes. The *administrative* process refers to any tasks keeping the hospital running and is not related to the treatment of a patient. The *clinical* process is restricted to licensed medical practitioners to operate within the scope of their licenses. Lastly, the *communication* process refers to the exchange of information via verbal, written or digital means. The complete list of clinical handover mnemonic devices and the respective processes and functions of their mnemonic elements can be found in Appendix 1.

Outcomes

Table 3 summarises the frequencies of all clinical functions identified in clinical handover mnemonic elements. Since a mnemonic element could carry multiple functions based on its description(s) in the literature, the sum of all frequencies is larger than the number of mnemonic elements. Our research showed that *medical condition (15.77%), medical history (14.62%), patient information (9.62%), medical evaluations (9.23%)*, *care plan (9.62%),* and *outstanding care/tasks/results (8.08%)* were the top six widely referenced functions in clinical handovers, and *responsibility, risk prevention and disaster recovery planning (6.92%), communication manner (6.54%)* and *validation (3.85%)* were also widely referenced in clinical handovers.

The mnemonics "Who, What, Where, When, How" (4W1H) and GRRRR are the two handover mnemonic devices focused only on the communication process in clinical handovers and do not relate to clinical or administrative processes. The 4W1H mnemonic device addresses five communication strategies in clinical handover: (1) WHO should participate in the sign-out process? (2) WHAT content needs to be verbally communicated? (3) WHERE should sign-out occur? (4) WHEN is the optimal time for sign-out? (5) HOW should verbal communication be performed? [13] GRRRR (Greeting, Respectful listening, Review, Recommend or request more information, Reward) was first proposed in 2007 [25] and was cited in two articles in 2015 [26] and 2019 [27].

Table 3 also shows 66.54% of handover mnemonic elements pass clinical process information to the receiver, 45.39% more than the administrative process and 54.23% more than the communication process. In our data, only 12.31% of mnemonic elements were related to communication processes, in which the validation and manner in the communication process shared 10.38%. These figures indicate that practitioners rated the communication process less critical in clinical handover than the other two processes.

Table 4 is a heat map showing the frequencies of all functions of each mnemonic device. The higher the frequency a function has, the darker the colour in red. The heat map shows clearly most of these mnemonics focused on the clinical process in handover, with a few exceptions. This finding confirms that clinical information about a patient's medical condition is the main area in clinical handovers, followed by administrative and communication elements.

Quality of the evidence

We collected the definitions of all mnemonics from the articles identified in PubMed query and the original articles cited by the respective article writers. Therefore, any discrepancy in the definitions was identified. Furthermore, the second author controlled the quality of the analysis and the results. The first author, who is a linguist, checked for any language variation in the definitions of each mnemonic.

Discussion

Statement of principal findings

By examining the clinical handover mnemonic devices reported in the literature, this study summarised the different processes and functions of clinical handover into a taxonomy.

Strengths and limitations

This study summarised 42 clinical handover mnemonics in the literature, 18 more than previously reported [8]. Our analysis showed the similarities and differences between the 238 elements of the 42 clinical handover mnemonics and the related clinical processes and functions. Since our literature search did not find previously reported taxonomy to describe the clinical processes and functions of clinical handover mnemonics, we summarised our findings on the 42 mnemonics to show the essential processes and functions in clinical handovers in a taxonomy. This taxonomy could help researchers systematically analyse unreported or newly developed clinical handover mnemonics and compare them with the mnemonics reported in this study. Hospital administrators and clinicians could also use this

taxonomy to construct and calibrate their clinical handover tools (e.g., standardised handover forms, electronic medical records reporting design, etc.).

This study has a few limitations. First, our systematic search on PubMed with a predefined search string may have excluded some mnemonics in the literature. Second, newer clinical handover mnemonics reported after the query completion date and mnemonics that have not been reported in literature could have been ignored. Third, our classification work was based on mnemonic element descriptions reported in the literature, and other descriptions beyond our collection of literature could be arbitrary. Finally, even though mnemonics have been used and reported as a helpful tool for clinical handover, there is a lack of evidence-based research to establish a direct relationship between the use of mnemonics and safer patient handovers [67].

Interpretation within the context of the wider literature

Surprisingly, our study found clinical handover mnemonics in similar acronyms or pronunciations. The most popular SBAR mnemonic and its variants had different interpretations in different scenarios. There are two ISBARs [17, 34-36] and one I-SBAR [23, 37] that carry different elements even though they have the same form. The same complication occurs in ISOBAR [35, 40] and iSoBAR [35, 41], which have similar forms and pronunciations. These similarities in forms could confuse and lower users' awareness and reduce the proposed mnemonic benefit of contributing to safer patient handovers, particularly during an inter-hospital patient handover. We also found an inadequate emphasis on the communication process in previous clinical handover mnemonics. We found most clinical handover mnemonic elements were related to the clinical process, and a few mnemonics transmit administrative information or strengthen clinical handover communication.

Clinical handover is a communication process in which a sender passes clinical and administrative information about one or more patients or wards to receivers. Information validation by reading back a summary or having a bedside shift handover will likely improve the quality of the communication. Any errors and misunderstandings could be verified, corrected, and rectified with additional information. The same observation applies to communication manner, which could enhance the interprofessional relationship of a team. As the communication accommodation theory suggests, communication styles and methods depend on the relationship between the parties [68], especially in a handover with an imbalance of hierarchical power relationship between communicating parties [62]. In some cases, the junior doctors may be reluctant to clarify the handed over information because they may feel discomfort and fear speaking up [62]. Therefore, it may be helpful if the lead handing over identified themselves at the beginning of a handover with a polite acknowledgement or thank you to close a conversation. Such communication behaviours could develop a positive working environment, strengthen the ingroup identity and create positive synergy within a group. Undoubtedly, many clinicians are good communicators, and some authoritative distance between different staff ranks is needed for effective team management in an emergency. However, emphasising information validation and ample communication manner could be helpful when information accuracy in clinical handover and building a cooperative working atmosphere are necessary. These findings have supported the need for a universal clinical handover taxonomy to standardise and mobilise accurate patient handovers, and our taxonomy could initiate the unification of clinical handover standards.

Nevertheless, there could be clinical handover mnemonics unreported in medical journals but which have been used in a clinical handover process. In such cases, our taxonomy could be a useful tool for those clinicians to calibrate and improve their clinical handover tools (i.e.,

forms, mnemonics, etc.) for safer clinical handovers, despite the languages and cultures in their workplace.

Implications for policy, practice and research

By showing the processes and functions behind clinical handovers, clinicians can connect, evaluate, and adapt to various clinical handover protocols and situations across different disciplines, hospitals, and institutions, thus improving clinical handover efficiency.

Our analysis has highlighted the prominent elements in clinical handovers that could be useful for developing new clinical handover tools. Our findings suggest that a patient's *medical condition* and *medical history* are the essential information to hand over to the incoming team, followed by the *patient's information*, the *care plan*, the outgoing physician's *medical evaluation* and *any outstanding care, tasks, or results*. This order could vary slightly for different departments or may disseminate only salient information depending on the patient's condition and the number of physicians in handovers. For example, designing an ED clinical handover protocol may rate clinical urgency more critical because of the time-critical nature of the ED, where patients' health conditions can deteriorate rapidly compared to a general ward. We propose that our findings may assist in the teaching of clinical handover by providing an overarching framework to examine the growing number of mnemonics.

Conclusions

This study summarised the different processes and functions of clinical handover by examining the clinical handover mnemonic devices reported in the literature. Although we recognise challenges because of both the vast number of clinical handover scenarios and the

task of placing them under a few predefined groups, our findings suggest that a taxonomy, such as developed for this study, could assist medical practitioners to devise a clinical handover mnemonic to best fit their workplace.

References

1. To Err is Human: Building a Safer Health System. Washington (DC): National Academies Press (US); 2000.
2. Leape LL, Berwick DM. Five years after To Err Is Human: what have we learned? Jama. 2005;293(19):2384-90.
3. Dzau VJ, Shine KI. Two Decades Since To Err Is Human: Progress, but Still a "Chasm". Jama. 2020;324(24):2489-90.
4. Kilpack V, Dobson-Brassard S. Intershift report: oral communication using the nursing process. J Neurosci Nurs. 1987;19(5):266-70.
5. Podder V, Lew V, Ghassemzadeh S. SOAP Notes. StatPearls. Treasure Island (FL): StatPearls Publishing; 2022.
6. Pearce PF, Ferguson LA, George GS, Langford CA. The essential SOAP note in an EHR age. Nurse Pract. 2016;41(2):29-36.
7. Australian Commission on Safety and Quality in Health Care. Implementation Toolkit for Clinical Handover Improvement. Sydney: ACSQHC; 2011.
8. Riesenberg LA, Leitzsch J, Little BW. Systematic review of handoff mnemonics literature. Am J Med Qual. 2009;24(3):196-204.
9. Hansten R. Streamline change-of-shift report. Nurs Manage. 2003;34(8):58-9.
10. Farhan M, Brown R, Woloshynowych M, Vincent C. The ABC of handover: a qualitative study to develop a new tool for handover in the emergency department. Emerg Med J. 2012;29(12):941-6.
11. Mathias JM. Passing the baton' for smooth handoffs. OR Manager. 2006;22(4):13.
12. Studer Group. AIDET Patient Communication n.d. [Available from: https://www.studergroup.com/aidet.

13. Vidyarthi AR, Arora V, Schnipper JL, Wall SD, Wachter RM. Managing discontinuity in academic medical centers: strategies for a safe and effective resident sign-out. J Hosp Med. 2006;1(4):257-66.

14. Budd HR, Almond LM, Porter K. A survey of trauma alert criteria and handover practice in England and Wales. Emerg Med J. 2007;24(4):302-4.

15. Fellows. S. FB. Paramedics: From Street to Emergency Department Case Book. Milton Keynes, United Kingdom: Open University Press; 2012. 176 p.

16. Waßmer RP. Kommunikations- und Patientenübergabemanagement in der Notfallmedizin 2009.

17. Ehlers P, Seidel M, Schacher S, Pin M, Fimmers R, Kogej M, et al. Prospective Observational Multisite Study of Handover in the Emergency Department: Theory versus Practice. West J Emerg Med. 2021;22(2):401-9.

18. Currie J. Improving the efficiency of patient handover. Emerg Nurse. 2002;10(3):24-7.

19. Talbot R, Bleetman A. Retention of information by emergency department staff at ambulance handover: do standardised approaches work? Emerg Med J. 2007;24(8):539-42.

20. Rudiger-Sturchler M, Keller DI, Bingisser R. Emergency physician intershift handover - can a dINAMO checklist speed it up and improve quality? Swiss Med Wkly. 2010;140:w13085.

21. Kwok ESH, Clapham G, White S, Austin M, Calder LA. Development and implementation of a standardised emergency department intershift handover tool to improve physician communication. BMJ Open Qual. 2020;9(1).

22. Ellis D, Mullenhoff, P. & Ong, F., editor Back to the Bedside. 2007 NACNS National Conference; 2007 February 28-March 3, 2007; Phoenix, Arizona.

23. Department of Defense Patient Safety Program. Healthcare Communications Toolkit to Improve Transitions in Care - Strategies and Tools to Improve Healthcare Handoffs and Transitions 2005 25 July 2022. Available from: https://login.ssmhealth.com/MyHR/Shared%20Documents/Nurse%20Residency%20Program%20Material/Class%206/I%20Pass%20The%20Baton%20REFERENCE.pdf.

24. Sandlin D. Improving patient safety by implementing a standardized and consistent approach to hand-off communication. J Perianesth Nurs. 2007;22(4):289-92.

25. American Nurse Association-California. GRRRR: Creating a Two-Way Process for Structured Communication. The Nurse's Voice. 2007;12(1):6.

26. Marquis BL, & Huston, C. J. Leadership roles and management functions in nursing: Theory and application. 8th ed. Philadelphia, PA: Lippincott,: Williams & Wilkins; 2015.

27. Bukoh MX, Siah CR. A systematic review on the structured handover interventions between nurses in improving patient safety outcomes. J Nurs Manag. 2020;28(3):744-55.

28. Brownstein A, & Schleyer, A. The art of HANDOFFS: A mnemonic for teaching the safe transfer of critical patient information. Resident and Staff Physician. 2007;53(6):15.

29. Suganandam D.K. Handoff Communication: Hallmark for Nurses. Indian Journal of Continuing Nursing Education. 2018;19(1).

30. Johnson M, Jefferies D, Nicholls D. Exploring the structure and organization of information within nursing clinical handovers. Int J Nurs Pract. 2012;18(5):462-70.

31. Iedema R, Ball C, Daly B, Young J, Green T, Middleton PM, et al. Design and trial of a new ambulance-to-emergency department handover protocol: 'IMIST-AMBO'. BMJ Qual Saf. 2012;21(8):627-33.

32. Starmer AJ, O'Toole JK, Rosenbluth G, Calaman S, Balmer D, West DC, et al. Development, Implementation, and Dissemination of the I-PASS Handoff Curriculum: A Multisite Educational Intervention to Improve Patient Handoffs. Academic Medicine. 2014;89(6):876-84.

33. Heilman JA, Flanigan M, Nelson A, Johnson T, Yarris LM. Adapting the I-PASS Handoff Program for Emergency Department Inter-Shift Handoffs. West J Emerg Med. 2016;17(6):756-61.

34. Thompson JE, Collett LW, Langbart MJ, Purcell NJ, Boyd SM, Yuminaga Y, et al. Using the ISBAR handover tool in junior medical officer handover: a study in an Australian tertiary hospital. Postgrad Med J. 2011;87(1027):340-4.

35. Klim S, Kelly AM, Kerr D, Wood S, McCann T. Developing a framework for nursing handover in the emergency department: an individualised and systematic approach. J Clin Nurs. 2013;22(15-16):2233-43.

36. Aldrich R DA, Lane K, Nair K, Hill KN.,. ISBAR revisited: identifying and solving barriers to effective clinical handover in inter-hospital transfer: final project report. Newcastle: Hunter New England Health; 2009.

37. Shahid S, Thomas S. Situation, Background, Assessment, Recommendation (SBAR) Communication Tool for Handoff in Health Care – A Narrative Review. Safety in Health. 2018;4(1):7.

38. Grbach W, Vincent, L., & Struth, D. Reformulating SBAR to "I-SBAR-R". Curriculum Developer for Simulation Education. 2008 [Available from: https://qsen.org/reformulating-sbar-to-i-sbar-r/.

39. Medical Education Simulation Center. I-SBAR-R: School of Medicine, University of California, Irvine; [Available from: https://cpb-us-e2.wpmucdn.com/sites.uci.edu/dist/2/2095/files/2019/10/I-SBAR-R.pdf.

40. Yee KC, Wong MC, Turner P. "HAND ME AN ISOBAR": a pilot study of an evidence-based approach to improving shift-to-shift clinical handover. Med J Aust. 2009;190(S11):S121-4.

41. Porteous JM, Stewart-Wynne EG, Connolly M, Crommelin PF. iSoBAR--a concept and handover checklist: the National Clinical Handover Initiative. Med J Aust. 2009;190(S11):S152-6.

42. McCann L, McHardy K, Child S. Passing the buck: clinical handovers at a tertiary hospital. N Z Med J. 2007;120(1264):U2778.

43. A nutty idea for patient handoffs. Briefings on Patient Safety. 2006;10:5-7.

44. Pass the baton or NUTS for safer handoff. Healthcare Risk Management. 2007;2022(23 August 2022).

45. Hodgetts T, Deane, S., Gunning, K. Trauma Rules. London: BMJ Publishing Group; 1997.

46. Schroeder SJ. Picking up the PACE: a new template for shift report. Nursing. 2006;36(10):22-3.

47. Arora V, Johnson J. A model for building a standardized hand-off protocol. Jt Comm J Qual Patient Saf. 2006;32(11):646-55.

48. Wilson R. Improving clinical handover in emergency departments. Emerg Nurse. 2011;19(1):22-6.

49. Guise JM, Lowe NK. Do you speak SBAR? J Obstet Gynecol Neonatal Nurs. 2006;35(3):313-4.

50. Velji K, Baker GR, Fancott C, Andreoli A, Boaro N, Tardif G, et al. Effectiveness of an Adapted SBAR Communication Tool for a Rehabilitation Setting. Healthc Q. 2008;11(3 Spec No.):72-9.

51. Hatten-Masterson SJ, Griffiths ML. SHARED maternity care: enhancing clinical communication in a private maternity hospital setting. Med J Aust. 2009;190(S11):S150-1.

52. Australian Commission on Safety and Quality in Health Care. OSSIE Guide to Clinical Handover Improvement. 2010.

53. Association of Perioperative Registered Nurses AORN. “Hand-off” Tool Kit to Improve Transitions in Care within the Perioperative Environment 2015 [Available from: https://www.aorn.org/-/media/aorn/guidelines/tool-kits/patient-hand-off/update-022016/handoff-over_tool%20kit%20executive%20summary.pdf?la=en.

54. Horwitz LI, Moin T, Green ML. Development and implementation of an oral sign-out skills curriculum. J Gen Intern Med. 2007;22(10):1470-4.

55. Sutcliffe KM, Lewton E, Rosenthal MM. Communication failures: an insidious contributor to medical mishaps. Acad Med. 2004;79(2):186-94.

56. Borhan N, Dharamsh R, Borhan F, Ahmed S, Gilmore R. 'TAG, You're It!' The high-stakes game of handovers in the Emergency Department - Improving handover quality using a new 'TAG' Protocol. Ir Med J. 2019;112(4):912.

57. Macarthur Health Service. Nursing the Acute Patient: Course Programme. 2005.

58. Shahrami A, Nazemi-Rafi M, Hatamabadi H, Amini A, Haji Aghajani M. Impact of Education on Trauma Patients' Handover Quality; a Before-After Trial. Arch Acad Emerg Med. 2019;7(1):e7.

59. Kang H, Nembhard HB, Rafferty C, DeFlitch CJ. Patient flow in the emergency department: a classification and analysis of admission process policies. Ann Emerg Med. 2014;64(4):335-42.e8.

60. Cronin JG, Wright J. Breach avoidance facilitator--managing the A&E 4-hour target. Accid Emerg Nurs. 2006;14(1):43-8.

61. Healy S, Tyrrell M. Stress in emergency departments: experiences of nurses and doctors. Emerg Nurse. 2011;19(4):31-7.

62. Manias E, Geddes F, Watson B, Jones D, Della P. Communication failures during clinical handovers lead to a poor patient outcome: Lessons from a case report. SAGE Open Med Case Rep. 2015;3:2050313x15584859.

63. Medical History 2012 [Farlex Partner Medical Dictionary]. Available from: https://medical-dictionary.thefreedictionary.com/medical+history.

64. Medical condition 2011 [Segen's Medical Dictionary.]. Available from: https://medical-dictionary.thefreedictionary.com/medical+condition.

65. Medical evaluation definition: 109 samples: Law Insider; [Available from: https://www.lawinsider.com/dictionary/medical-evaluation

66. Wickramasinghe N, editor. Handbook of Research on Healthcare Administration and Management. Hershey, PA, USA: IGI Global; 2017.

67. Cheung DS, Kelly JJ, Beach C, Berkeley RP, Bitterman RA, Broida RI, et al. Improving handoffs in the emergency department. Ann Emerg Med. 2010;55(2):171-80.

68. Giles H. Communication Accommodation Theory. The International Encyclopedia of Communication Theory and Philosophy. p. 1-7.

69. Association of periOperative Registered Nurses AORN. Standardizing Hand offs for Patient Safety 2006 [Available from: https://www.aorn.org/-/media/aorn/guidelines/tool-kits/patient-hand-off/patient-hand-off-presentation-standardizing-hand-offs.pptx?la=en.

70. Cory J. First aid acronyms explained – mist. first aid training cooperative: First Aid Training Cooperative; 2019 [Available from: https://firstaidtrainingcooperative.co.uk/acronyms-

mist/#:~:text=M%20%E2%80%93%20Mechanism%20of%20Injury&text=If%20a%20casualty%20was%20hiking,the%20mechanism%20would%20be%20poisoning.

Table 1: Forty-two clinical handover mnemonic devices and their mnemonic elements in this study

Mnemonics devices	Mnemonic elements in the acronym	Source(s)
4 P's	[P]urpose; [P]icture; [P]lan; [P]art	[8, 9]
ABCDE	[A]reas and allocation; [B]eds, Bugs, Breaches; [C]olleagues, Consultant on Call; [D]eaths, Disasters, Deserters; [E]quipment, External Events.	[10]
AIDET	[A]cknowledge the patient; [I]ntroduce yourself; [D]uration of the procedure; [E]xplanation of process and what happens next; [T]hank you for choosing our hospital (note: handoff done at bedside).	[8, 11, 12]
ANTICipate	[A]dministrative information; [N]ew clinical information, specific; [T]asks to be performed, assessment of severity of [I]llness, and [C]ontingency plans or anticipated problems.	[10, 13]
ASHICE	[A]ge; [S]ex; [H]istory; [I]njuries; [C]ondition; [E]xpected time of arrival	[8, 14, 15]
BAUM	[S]ituation [German: Bestand]; [A]namnesis; [E]xamination [German: Untersuchung]; [M]easures.	[16, 17]
CUBAN	[C]onfidential; [U]ninterrupted; [B]rief; [A]ccurate; [N]amed personnel.	[8, 18]
DeMIST	Patient [de]mographics; [M]echanism of injury; [I]njuries sustained; [S]ymptoms and signs; [T]reatments given	[8, 19]

diNAMO	[D]octor, remember!; [I]dentity (age, sex, name); [N]eeds Of the patient (Chief complaints); [A]nalysis (State Of the evaluation); [M]edical management (planned evaluation or treatment); [O]rganisation (planned transfer, discharge).	[20]
ED-VITALS	[E]ntity; [D]iagnosis; [V]itals; [I]nvestigations; [T]reatments; [A]ctions; [L]ogisitics; [S]ervices.	[21]
Five-Ps (1st version)	[P]atient; [P]lan; [P]urpose; [P]roblems; [P]recautions; (Physician assigned to coordinate (Captain of the ship)).	[22, 23]
Five-Ps (2nd version)	[P]atient (identify); [P]recautions (allergies, isolation, falls, specialty bed); [P]lan of Care (fluids, intake, output, intravenous access); [P]roblems (assessment, review of systems, pain scale, etc); [P]urpose (goals to be achieved)	[24]
GRRRR	[G]reeting; [R]espectful listening; [R]eview; [R]ecommend or request more information; [R]eward	[25-27]
HANDOFFS	[H]ospital Location ; [A]llergies/ Adverse; [N]ame; [D]NR/Diet/ DVT prophylaxis; [O]ngoing Medical surgical problems; [F]acts about current hospitalization; [F]ollow up; [S]cenario.	[8, 28, 29]
I PASS the BATON	[I]ntroduction; [P]atient details; [A]ssessment: presenting chief complaint, vitals; [S]ituation: current status; [S]afety concerns: critical laboratory results, allergies; [B]ackground; [A]ctions taken and required for later; [T]iming; [O]wnership; [N]ext.	[23, 27]
ICCCO	[I]dentification of the patient and clinical risks; [C]linical history/presentation; [C]linical status; [C]are plan;	[27, 30]

	[O]utcomes/goals of care.	
IMIST-AMBO	[I]dentification of the patient; [M]echanism/medical complaint; [I]njuries/information relative to the complaint; [S]igns, vitals and GCS; [T]reatment and trends/response to treatment; [A]llergies; [M]edications; [B]ackground history; [O]ther (social) information (IMIST-AMBO)	[17, 31]
I-PASS	[I]llness severity; [P]atient summary; [A]ction list; [S]ynthesis by receiver; [S]ummary by receiver (after all patients are presented).	[32, 33]
ISBAR (v2)	[I]dentity of patient; [S]ituation; [B]ackground; [A]ssessment and action; [R]esponse and rationale.	[34, 35]
ISBAR (v1)	[I]dentification, [S]ituation, [B]ackground, [A]ssessment, [R]ecommendation.	[17, 36]
I-SBAR	[I]ntroduction; [S]ituation; [B]ackground; [A]ssessment; [R]ecommendation.	[23, 37]
I-SBAR-R	[I]ntroduce; [S]ituation; [B]ackground; [A]ssessment; [R]ecommendation; [R]ead back.	[38, 39]
ISOBAR	[I]dentification of patient; [S]ituation and status; [O]bservations of patient; [B]ackground and history; [A]ction, agreed plan and accountability; [R]esponsibility and risk management.	[35, 40]
iSoBAR	[I]dentify; [S]ituation; [O]bservations; [B]ackground; [A]greed plan; [R]ead back.	[35, 41]
JUMP	[J]obs outstanding; [U]nseen patients; [M]edical contacts;	[10, 42]

	[P]atients to be aware of.	
Just Go NUTS	[N]ame; [U]nusual factors; [T]ubes; [S]afety concerns.	[8, 43, 44]
M.I.S.T. Report	[M]echanism; [I]njuries; [S]igns/Symptoms; [T]reatment.	[8, 19, 45]
PACE	[P]atient/Problem; [A]ssessment/actions; [C]ontinuing/changes; [E]valuation.	[27, 46]
PEDIATRIC	[P]roblem list; [E]xpected tasks to be done; [D]iagnostic one-liner; [I]f /then; [A]dministrative data/advanced directives; [T]herapeutics; [R]esults and other important facts; [I]V access/invasive devices; [C]ustody and current issues.	[8, 47]
P-VITAL	[P]resent; [V]ital signs; [I]nput and output; [T]reatment and diagnosis; [A]dmission or discharge; [L]egal issues.	[48]
SBAR	[S]ituation; [B]ackground; [A]ssessment; [R]ecommendation.	[35, 49, 50]
SBARR	[S]ituation; [B]ackground; [A]ssessment; [R]ecommendation; [R]esponse or read back	[8, 49]
SBAR-T	[S]ituation; [B]ackground; [A]ssessment; [R]ecommendation; [T]hank patients for opportunity to work with them (note: handoff done at bedside)	[8]
SHARED	[S]ituation; [H]istory; [A]ssessment; [R]isk; [E]vents; [D]ocumentation.	[35, 51, 52]
SHARQ	[S]ituation (describe the situation); [H]istory (past medical history, allergies, home medications); [A]ssessment (current medications, intake, output, status); [R]ecommendations (recommendations, results, discharge planning); [Q]uestions	[29, 53]

	(opportunity to ask questions).	
SIGNOUT	[S]ick or DNR; [I]dentifying data; [G]eneral hospital; [N]ew events of the day; [O]verall health status/ clinical condition; [U]pcoming possibilities with plan, rationale; [T]asks to complete with plan, rationale.	[29, 54]
SOAP	[S]ubjective; [O]bjective; [A]ssessment; [P]lan (SOAP)	[4, 8, 19]
STICC	[S]ituation; [T]ask; [I]ntent; [C]oncern; [C]alibrate.	[27, 55]
TAG, You're it!	[T]arget; [A]ssessment; [G]ame Plan.	[56]
VITAL	[V]ital signs; [I]nput and output patterns; [T]reatments; [A]mbulatory abilities; Relevant [l]egal documents.	[48, 57]
WHO MISSED IP?	[Who] (patient ID as patient's name, sex, age and pre-injury health status), [M]echanism of trauma, [I]njury (suspected or sustained), [S]ign & [S]ymptom (containing observations and monitoring), [E]valuation (Imaging, laboratory, etc.), [D]iagnosis, [I]ntervention (therapy and consulting), [P]lan for patient management, and [?] giving an opportunity to question in the case of any ambiguity.	[58]
Who, What, Where, When, How (aka. 4W1H)	[WHO] should participate in the signout process? [WHAT] content needs to be verbally communicated? [WHERE] should signout occur? [WHEN] is the optimal time for signout? [HOW] should verbal communication be performed?	[10, 13]

Table 2: Summary of processes and functions identified from the elements in the forty-two handover mnemonic devices

Process	Function	Definition and examples
Administrative	*Patient information*	"Patient information" refers to the identity, condition, or procedure information for non-professional audiences.
	Discharge plan	"Discharge plan" ensures the smooth transition of patients from hospitals to outpatient services.
	Medical Social Services	"Medical social services" refers to psychological and social support for patients and their families.
	Staffing and resources	"Staffing and resources" support a hospital's objectives, operations, and services to meet the regulatory and service requirements.
	Legal and regulations	"Legal and regulations" refers to laws, ordinances, decrees, and other institutional requirements and professional codes.
	Responsibility, risk prevention and disaster recovery planning	"Responsibility, risk prevention and disaster recovery planning" is to confirm shared understanding and transfer of responsibility, including safety concerns and contingency planning for unanticipated events or incidents.
Clinical	*Clinical urgency*	An indicator for clinicians to prioritise the order of treating patients according to their medical conditions.

		Clinicians are licensed practitioners to determine the urgency of patients and adjust their clinical urgency if a patient's medical conditions deteriorate suddenly.
	Medical history	A narrative or record of past events and circumstances that are or may be relevant to a patient's current state of health. [63]
	Medical condition	An objective description of the biological or psychological state outside the range of a normal human variation. [64]
	Medical evaluation	To "access an individual's health status, including the medical history and a physical examination of the patient". [65]
	Medical diagnosis	Medical diagnosis is the process of determining which disease explains a person's symptoms and signs. [66]
	Outstanding care/tasks/results	Any short-term events that can occur and a plan pertaining to it. Expected tasks to be done, such as results and outstanding care.
	Care plan	A formal treatment plan for a patient delineated by the treating physician based on knowledge of the patient's medical condition.
Communication	*Culture*	A normative set of rules, syntax, semantics and synchronisation of communication and possible error recovery methods that is shared by an ingroup.
	Environment	Communication settings available to communicators.

Participants	Parties involved in a communication process.
Mode	The mode of communication could be verbal, written or via a medium synchronously or asynchronously.
Manner	The cultural and professional codes and communication strategies shared across communicating parties for achieving a designated communication goal.
Timing	The time and duration of a communication event.
Validation (e.g., Read back)	Validation is used to prevent errors by counterchecking the received information by readback, checking the care plan and medical report for any discrepancies, etc. If a discrepancy is found, the receiver will seek further clarification from the sender.

Table 3: Frequencies of clinical handover functions of the three processes.

Process	Function	Freq.	Subtotal
Administrative	*Patient information*	25	9.62%
	Discharge plan	4	1.54%
	Medical Social Services	1	0.38%
	Staffing and resources	3	1.15%
	Legal and regulations	4	1.54%
	Responsibility, risk prevention and disaster recovery planning	18	6.92%
	Administrative process sub-total	55	21.15%
Clinical	*Clinical urgency*	11	4.23%
	Medical history	38	14.62%
	Medical condition	41	15.77%
	Medical evaluation	24	9.23%
	Medical diagnosis	13	5.00%
	Outstanding care/tasks/results	21	8.08%
	Care plan	25	9.62%
	Clinical process sub-total:	173	66.54%
Communication	*Culture*	1	0.38%
	Environment	1	0.38%
	Participants	1	0.38%
	Mode	1	0.38%
	Manner	17	6.54%
	Timing	1	0.38%
	Validation	10	3.85%
	Communication process sub-total:	32	12.31%

Total occurrences*:	260	100.0%

* Remarks: A mnemonic element could carry multiple functions based on their descriptions in the literature.

Table 4: Frequencies of all functions of each mnemonic device as a heat map

Mnemonics	Patient information	Discharge plan	Medical Social Services	Staffing and resources	Legal and regulations	Responsibility, risk prevention and disaster recovery planning	Clinical urgency	Medical history	Medical condition	Medical evaluation	Medical diagnosis	Outstanding care/tasks/results	Care plan	Culture	Environment	Participants	Mode	Manner	Timing	Validation (Read back)	Administrative process	Clinical process	Communication process
4 P's	0	0	0	0	0	1	1	1	2	0	0	0	1	0	0	0	0	0	0	0	1	5	0
ABCDE	0	0	1	3	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	10	1	0
AIDET	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	3	0	0	0	2	3
ANTICipate	1	0	0	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	1	4	0
ASHICE	2	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	2	4	0
BAUM	0	0	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	4	0
CUBAN	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	2	0	3
DeMIST	1	0	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	1	4	0
diNAMO	1	1	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	2	3	0
ED-VITALS	1	1	0	0	0	1	0	2	1	1	1	1	0	0	0	0	0	0	0	0	3	6	0
5Ps (v1)	1	0	0	0	0	1	0	0	1	0	1	0	2	0	0	0	0	0	0	0	2	4	0
5Ps (v2)	1	0	0	0	0	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	1	4	0
GRRRR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	0	0	5
HANDOFFS	2	0	0	0	0	0	0	3	1	0	0	2	0	0	0	0	0	0	0	0	2	6	0
I PASS the BATON	1	0	0	0	0	1	1	2	2	1	0	1	1	0	0	0	0	1	0	0	2	8	1
ICCCO	1	1	0	0	0	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	3	3	0
IMIST-	2	0	0	0	0	0	0	3	3	1	0	0	0	0	0	0	0	0	0	0	2	7	0

AMBO																							
I-PASS	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	2	0	4	2	
ISBAR (v2)	1	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	2	6	0	
ISBAR (v1)	1	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1	4	0	
I-SBAR	2	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	2	0	0	2	6	2
I-SBAR-R	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	1	0	1	0	4	2
ISOBAR	1	0	0	0	0	2	0	1	1	1	0	1	1	0	0	0	0	0	0	0	3	5	0
iSoBAR	0	0	0	0	0	0	0	2	1	0	0	0	1	0	0	0	0	1	0	1		4	2
JUMP	0	0	0	0	0	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0	1	3	0
Just Go NUTS	1	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	2	2	0
M.I.S.T. Report	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	4	0
PACE	1	0	0	0	0	0	0	0	0	1	2	1	1	0	0	0	0	0	0	0	1	5	0
PEDIATRIC	1	0	0	0	0	1	0	1	0	1	1	2	2	0	0	0	0	0	0	0	2	7	0
P-VITAL	1	1	0	0	1	0	0	0	2	0	2	0	1	0	0	0	0	0	0	0	3	5	0
SBAR	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	4	0
SBARR	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	1	0	4	1
SBAR-T	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	1	0	0	0	4	1
SHARED	0	0	0	0	1	0	0	1	1	1	0	1	1	0	0	0	0	0	0	0	1	5	0
SHARQ	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	1	0	4	1
SIGNOUT	1	0	0	0	0	0	1	1	2	0	1	1	1	0	0	0	0	0	0	0	1	7	0
SOAP	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	4	0
STICC	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	1	0	4	1
TAG, You're it!	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	2	0

VITAL	0	0	0	0	1	0	0	0	3	0	0	1	0	0	0	0	0	0	0	1	4	0
WHO MISSED IP?	1	0	0	0	0	0	0	2	1	1	1	1	1	0	0	0	0	0	1	1	7	1
4W1H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	5

End-matter

Contributorship

H.W.Y. conceptualised the research idea, collected, and analysed data, drafted the manuscript, and participated in critical revisions.

C.S.P. participated in analysed data and validation.

B.W. participated in critical revisions, review and editing, and supervision.

We confirm that all authors have read and approved the final version of the manuscript.

Ethics and other permissions

This study does not require ethics approval since it involves textual analysis of handover mnemonics in the literature.

Funding

This work was supported by a grant from the Faculty of Humanities, The Hong Kong Polytechnic University [P0038376 to B.W.].

Conflict of Interests

No known conflict of interests.

Acknowledgements

We would like to thank Geoffrey Watson for his contributions in piloting the taxonomy of this study.

Data Availability Statement

Data are available on reasonable request.