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*Published in:*  
International Journal of Medical Informatics

*DOI (link to publication from Publisher):*  
[10.1016/j.ijmedinf.2018.03.007](https://doi.org/10.1016/j.ijmedinf.2018.03.007)

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*Publication date:*  
2018

*Document Version*  
Accepted author manuscript, peer reviewed version

[Link to publication from Aalborg University](#)

*Citation for published version (APA):*  
Tariq, A., Baysari, M., Pedersen, C. H., Andersen, M. V., Larsen, M. M., Shahi, M., Beveridge, A., & Westbrook, J. (2018). Examining barriers to healthcare providers' adoption of a hospital-wide electronic patient journey board. *International Journal of Medical Informatics*, 114, 18-26. <https://doi.org/10.1016/j.ijmedinf.2018.03.007>

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# Examining barriers to healthcare providers' adoption of a hospital-wide electronic patient journey board

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## ***Abstract***

**Background:** The dynamic environment that characterizes patient care in hospitals requires extensive communication between staff. Electronic status board applications are used to improve the flow of communication in hospitals. To date there has been limited work exploring the adoption of these application in general acute ward settings.

**Aim:** This study aimed to identify barriers to the adoption of an electronic patient journey board (EPJB) <sup>1</sup> application in acute wards of a hospital.

**Method:** Data was collected at a large public teaching hospital in XXX, XXX. The EPJB was implemented across all hospital wards with the aim improve multidisciplinary communication in wards. Observations (29.5 hours) and contextual interviews (n=33) with hospital staff were conducted in two acute wards of the hospital.

**Results:** Two manual whiteboards were used on wards, in addition to the EPJB, to compensate for information not being available or accessible on the EPJB. Despite the stated purpose of the EPJB, the tool did not appear to support team communication on wards. Barriers to adoption and optimal use of the EPJB included inappropriate location and configuration of the system, limitations in information timeliness, quality and lack of customisation (for different user groups), inconsistent information updates and the absence of a shared understanding of the purpose of the EPJB among the various user groups.

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<sup>1</sup> Electronic Patient Journey Board (EPJB)

**Conclusion:** Multiple socio-technical barriers influenced the uptake and optimal use of the EPJB by the healthcare providers. Engaging users early in the design and implementation of electronic status board applications is required to ensure effective use of these complex interventions on general wards.

**Key Words:** *communication, electronic status boards, hospitals, wards*

## **Introduction**

Healthcare is characterized by complex processes of patient care which require extensive communication among healthcare providers <sup>[1,2]</sup>. Information needed to provide appropriate patient care is often recorded in several places across various mediums. Thus, healthcare providers can spend a lot of time gathering information, which may not always be easy to locate <sup>[3]</sup>.

Over the last few decades, manual dry-erase whiteboards have been readily used in healthcare settings to improve the information flow between care providers. These whiteboards have become ubiquitous tools in hospitals to facilitate communication and coordination of care, especially within Emergency Departments (EDs) <sup>[4,5]</sup>. The information on whiteboards is typically structured in a matrix-like format, displayed in a central location, <sup>[4,6,7]</sup> and includes patient demographics, caregiver assignments, multidisciplinary referrals, status of tests, and discharge planning.

With the increasing penetration of information technology in healthcare settings, there has been a transition from use of manual dry-erase whiteboards to electronic whiteboards, also referred to in the literature as electronic status boards and electronic patient tracking systems <sup>[8, 9]</sup>. These electronic status boards often contain the same matrix format, structure and content as manual dry-erase whiteboards <sup>[4]</sup>, however they overcome a number of limitations of manual whiteboards, including space, loss of information after deletion, no integration with other clinical information systems and the inability to communicate updates in real-time <sup>[10]</sup>. The status board applications are typically positioned on large wall mounted visual display screens and provide users with the capacity to interact with

the system primarily via keyboard and mouse (for example Figure 1) [20-26]. Some studies, conducted within the context of EDs, report that electronic status boards also have interactive touch screens for enhanced user interactions [15, 16, 22].



**Figure 1: Example View of Electronic Status Board in an ED [p. 1034, 26]**

The users of these electronic status board applications range from administrative staff, to nurses distributing work assignments and reviewing patient status, to doctors and allied health staff retrieving and discussing patient information. Electronic status boards must therefore support teamwork as well as individual use [2, 11].

To date, EDs and intensive care units (ICUs) have been the primary implementation environments for electronic status and whiteboard applications. Several studies have investigated the effect of electronic status boards on work processes in these settings and reported mixed results [11-17;21-22]. Patterson et al. used ethnographic observations to explore the use of electronic whiteboards (and manual whiteboards) in two EDs in the US [11]. They found that very few people used the electronic whiteboard (three of the 23 participants observed), while all participating physicians used the manual whiteboards. Clinicians with an

administrative role appeared to use the electronic whiteboard more extensively than those less involved in patient administration <sup>[11]</sup>. In another US study, time in motion, and primary task analysis methods were used to study physician behavior in the presence of an electronic whiteboard <sup>[14]</sup>. It was found that it was readily used within the ED and the physician viewing of and interaction with the electronic whiteboard represented 19.3% (n = 396) of all clinical tasks observed during the study <sup>[14]</sup>. Some studies have also reported negative effects of electronic whiteboard implementation on ED workflow. For example, several user-interface issues (e.g. size of information fields) that limit optimal use of electronic whiteboard were identified via administration of a pre-post implementation survey with users (40% response rate) at two EDs and a paediatric department in Denmark <sup>[16]</sup>. Lack of flexibility has also been identified as an issue with the electronic whiteboard applications, as opposed to the manual dry-erase whiteboard where information can be adjusted to time and preference <sup>[11]</sup>.

Despite mixed outcomes on adoption and success in EDs, many hospitals are now moving towards increasing the scope of electronic status board implementation to all wards of the hospital <sup>[12, 17]</sup>. One hospital that did this in 2013 was a large metropolitan teaching hospital in Sydney, one of the first hospitals in Australia to introduce an electronic patient journey board (EPJB) across all of its inpatient wards. The key purpose of the EPJB was to facilitate team communication within wards and improve the efficiency of key hospital processes like discharge planning. However, since its introduction there were anecdotal reports of limited uptake of EPJB by staff on hospital wards. This motivated an examination of the reasons for the limited adoption. The aim of this study was to examine the



adoption of an electronic patient journey board in acute wards of a hospital and to identify any barriers to its adoption and optimal use. We were also interested in identifying any barriers that were specific to the acute ward setting, as there has been limited work examining this context of use.

## **Methods**

### ***Research Setting***

The study was conducted in a large teaching public hospital in metropolitan XXX, XXX, XXX. Two acute wards (ward 1: medical and surgical, ward 2: medical ward) using the EPJB application since 2013 were approached and invited to participate in the study. The wards were selected purposively, as the staff members on one ward were perceived to be adopting the EPJB as intended, and staff on the other were not.

Ward 1 has 56 staff members consisting of 8 doctors and 48 nursing staff members. Ward 2 has 20 staff members consisting of 6 doctors and 14 nursing staff members. Allied health staff work across different wards on an as required basis.

The hospital has a number of information systems in place, including electronic test ordering and reporting, medication management, paging, rostering and clinical documentation. Patient progress notes were not electronic.

### ***Study Design***

A contextual inquiry approach, using non-participant observations and contextual interviews, was used to collect data for the study, where users of the EPJB were observed and interviewed during their routine work activities. The conceptual basis of contextual inquiry was well suited to this study because it offers the ability to conduct an in-depth examination of users' interactions with artefacts within their work context <sup>[18]</sup>. The users of the EPJB (i.e. doctors, nurses, nurse unit managers (NUMs), the nurse manager and allied health staff) were observed and interviewed to explore their perceptions of the role of the EPJB to support their routine work and potential barriers to optimal usage. Principal observations and interviews were carried out in the medical workroom where the EPJB was displayed on a large screen. Some supplementary observations and interviews were conducted at workstations and working areas on the wards. In addition, various artefacts (e.g. business documents, manual whiteboards etc.) related to the use of EPJB and mentioned by interviewees were also examined to further provide clarity around data collected during observations and interviews.

Ethics approval was obtained from the hospital's human research ethics committee (HREC) and informed written consent was obtained from all participants in the study.

### ***Data Collection***

An initial information session (2 hours) with one of the nurse unit managers who was actively involved in EPJB implementation facilitated in understanding why the EPJB had been implemented and the context of use. During the session, a business

document describing the purpose and rules for updating the EPJB was shared with the research team to facilitate understanding of the various user groups and their role in maintaining the information within EPJB.

Based on the information session, a research team meeting facilitated in identifying the key dimensions of data collection. To identify barriers to optimal use of EPJB on wards, data collection focused on the following three main contextual dimensions of EPJB use: I) the flow of information to and from the EPJB, II) the roles of different users of the EPJB III) information artefacts used in addition to the EPJB to support care coordination activities on the wards. These additional artefacts included patient lists i.e. a print-out list of all patients admitted on the ward and the manual whiteboards

To observe interactions with the EPJB, routine ward activities were observed and we focused on observing team coordination activities including rapid rounds, multidisciplinary team (MDT) meetings and length of stay (LOS) meetings. Table I presents an overview of these team coordination activities.

**Table I: Key care coordination processes where the EPJB could potentially be used.**

Team coordination activity	Overview
<b>Handover</b>	Transmission of information from the current shift to the new shift. Occurs at least three times (15 – 20 minutes) within 24 hours after the end of each shift.
<b>Rapid Round</b>	A meeting among doctors, nurses and the NUM to assess all patients on the ward. Occurs during morning shifts on weekdays for approximately 20 minutes per round.

<b>Multi-disciplinary team meeting</b>	A two-hour weekly meeting to assess all patients on the ward. Doctors, nurses, the NUM and allied health staff are present.
<b>Length of stay meeting</b>	A weekly assessment of all patients admitted for 6 days or longer in order to move them towards discharge.

NUM= Nurse unit manager

Three researchers (MML, CHP, MVA), experienced in collecting qualitative data, undertook the observations and interviews. At least two researchers were present at each session. In total, 34.5 hours (Avg 4 hours/day) of observations were undertaken over a period of two weeks. In addition to observing general ward activities, the researchers observed three rapid rounds and three LOS meetings. The majority of observations took place during the daytime shift at the hospital, however one 3.25-hour session was undertaken in the evening to identify any differences in EPJB across day and evening shifts.

Thirty-three short contextual interviews were conducted across diverse groups of EPJB users as summarised in Table II. The interview guide (Appendix A) facilitated in conducting the interviews. The goal of these fast-paced interviews was to supplement the observations (i.e. provide explanations for what was being observed). Extensive handwritten notes were taken during observations and interviews. In addition, de-identified samples of paper-based artefacts and screenshots of electronic information artefacts were collected.

**Table II: Distribution of participants for contextual interviews**

<b>Participant Type</b>	<b>Number of Contextual Interviews</b>
<i>Average duration per interview: 11 mins</i>	
<b>Doctors</b>	7
<b>Nurses</b>	14
<b>Nurse unit managers</b>	3
<b>Pharmacists</b>	1
<b>Allied health staff</b>	6
<b>Complex care coordinators</b>	2
<b>Total</b>	<b>33</b>

## **Analysis**

Iterative inductive thematic analysis was conducted to identify barriers to the adoption of the EPJB on wards. The interview guide (Appendix A) guided initial coding of the data. After each data collection session, the three researchers debriefed to compare and collate notes. Which was then collated as the data collection notes for that particular day.

In addition, multiple periodic meetings (n=7, 1 hour/meeting) with the extended research team were held to iteratively analyse the data and identify barriers to use of the EPJB <sup>[18]</sup>. During these meetings, the data collection team led the meeting by presenting the key findings and associated themes. The themes were then reviewed by the other members of the research team to ensure that they adequately addressed the subject matter and accounted for the content of the data from observations and interviews. The themes were also reviewed by one of the study participants (a doctor), from outside the sampling frame but with knowledge of the subject matter.

## **Results**

This section first provides an overview of the EPJB application, which is followed by a description of its observed usage patterns and the barriers identified to its adoption.

### ***The Electronic Patient Journey Board (EPJB)– An overview***

The application being used in the hospital is a home-grown EPJB solution. It is accessible from all mobile and desktop workstations on wards. Optional training sessions were held for all staff members at the time of introduction.

**Purpose of EPJB:** Based on the initial information session held with the NUM, and the business document for the EPJB, the EPJB is a centralised principal communication artefact that facilitates teamwork on wards (e.g. discharge planning) and provides real-time information to be used in discussions during handovers and multidisciplinary team meetings. The EPJB was designed to serve as a communication tool to share key information (e.g. patient flow, expected discharge date (EDD) and referral status) among doctors, nurses, pharmacists, allied health professionals and administration staff in order to support high quality, safe and timely care.

**Information Design of EPJB:** The EPJB contains information about every patient admitted on a ward. Figure 2 shows a screen shot of the EPJB interface. The information displayed includes: 1) *Patient demographics and admission details:* bed number, medical record number, patient name and age, Attending Medical Officer (AMO) – the consultant responsible for the individual patient during admission, admitted unit, length of stay (LOS), alerts, expected discharge date, and

discharge summary status (started/complete). 2) *Patient care related information:* medication status, medical imaging (MI) and *patient flow/waiting for* – this column on the EPJB presents information about potential issues that may delay the patient’s hospitalization or required actions or problem solving (e.g. “Analgesia for pain, if patient agrees,” “worsening back pain” or “MRI Monday”). 3) *Patient care related information from allied health staff:* referrals from diet and nutrition (DN), physiotherapy (PT), speech pathology (SP), occupational therapy (OT), social work needs (SW) and rehabilitation (RH), which can be categorized as ordered (red), pending (yellow) or complete (green). This traffic light system used by the EPJB is to enable quick identification of patients’ status and facilitate discharge planning (Figure 1).

Bed	MRN	Patient	ADO	UNIT	Age	Alerts	LOS	Disch	Reason for EDD Chg	Meds	MI	DS	DN	PT	SP	OT	SW	RH	Patient Flow/Waiting For
X3901		Open																	
X3902			GER	72	🚨🚨🚨🚨🚨	6			MO - Discharge 2-3 days			🔴	🔴	🟡	🟢	🟢	🟢	🟢	🟢
X3903			PGU	82	🚨🚨	34			MO - Discharge more than 3 days			🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3904			GER	89	🚨🚨	5			MO - Discharge 2-3 days			🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3905			GER	76	🚨🚨	3			MO - Discharge more than 3 days			🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3906			PGU	76	🚨🚨	41	17/10		Waiting for a Nursing Home/Hostel, MO - Discharge 2-3 days			🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3907			GER	94	🚨🚨	7			MO - Discharge more than 3 days	🟡		🔴	🔴	🟡	🟢	🟢	🟢	🟢	🟢
X3908			PGU	74	🚨🚨	8	15/10		MO - Discharge more than 3 days			🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3909			GER	86	🚨🚨	13	16/10		Awaiting ACAT, MO - Medically fit for Discharge			🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3910			GER	89	🚨🚨	7			Waiting for a Nursing Home/Hostel, MO - Medically fit for Discharge			🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3911			GER	81	🚨🚨	7			MO - Discharge 2-3 days			🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3912			GER	93	🚨🚨	7			MO - Discharge more than 3 days	🟡		🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3913			GER	71	🚨🚨	14			MO - Discharge more than 3 days		Oct 14	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3914			GER	93	🚨🚨	10			MO - Discharge more than 3 days			🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3915			GER	90	🚨🚨	8	15/10		MO - Discharge more than 3 days			🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3916			GER	80	🚨🚨	12			MO - Medically fit for Discharge, Waiting for a Nursing Home/Hostel	🟡		🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3917			GER	88	🚨🚨	4			MO - Discharge 2-3 days			🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3918			GER	79	🚨🚨	17	15/10		MO - Medically fit for Discharge, Waiting for Rehab/Respite Bed			🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3919			GER	89	🚨🚨	2			MO - Discharge more than 3 days			🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢
X3920			PGU	82	🚨🚨	12			MO - Discharge more than 3 days			🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢

Figure 2: Screenshot of the electronic white board at the study hospital.

The information displayed on the EPJB is automatically extracted from the patient administration system and from the hospital's clinical information system. All staff on the ward have pre-defined responsibilities with respect to keeping the information up to date in the complementary systems, which then populates the EPJB (Figure 3). Nursing staff need to order referrals through the hospital's clinical information system first, to enable allied staff to update their status.

Section(s)	In hours responsible	Out of hours responsible
Name, AMO, Specialty	CSO/ Ward clerk	Team Leader
EDD – Estimated Date of Discharge	JMO/Care Coordinator	Team leader
Reason for EDD change	JMO/Care Coordinator	Team Leader
Meds - Medications	JMO	JMO
MI -Medical Imaging	JMO	JMO
DS – Discharge Script	JMO	JMO
PT - Physiotherapy	Referral – All Status update – Physiotherapist	Referral – All Status update – Physiotherapist
OT – Occupational Therapy	Referral – All Status update – Occupational Therapist	Referral – All Status update – Occupational Therapist
SW – Social Work	Referral – All Status update – Social Worker	Referral – All Status update – Social worker
SP – Speech Pathology	Referral – All Status update Speech Pathologist	Referral – All Status update – Speech Pathologist
DN- Dietician	Referral – All Status update Dietician	Referral – All Status update – Dietician
RH- Rehabilitation	Referral – All Status update – Rehab CNC	Referral – All Status update – Rehab CNC (Refer to Rehabilitation Business Rules)
Patient flow/waiting for	All. Monitored updated by TL	All. Monitored updated by TL
Nursing patient allocation	Team Leader	Team leader/In charge

Figure 3: Responsibilities for updating the EPJB at the study hospital.<sup>2</sup>

**Location of EPJB :** The EPJB is displayed on a large non-touch display screen in study wards in the medical workroom (an office space with several computers, where nurses and doctors can review notes, receive calls etc.). Interaction with the screen was only possible via the use of a mouse and keyboard.

<sup>2</sup> CSO: Clinical Support Officer, JMO: Junior Medical Officer, CNC: Clinical Nurse Consultant, TL: Team Leader



In addition to the medical workroom, the study wards are equipped with six computer workstations and eight mobile workstations with laptops. The EPJB is accessible from all desktop and mobile workstations. The layout of our two study wards is almost identical. Figure 4 shows a map of a general ward, where workstations are marked with a red circle. The placement of the EPJB in the medical workroom and the placement of two manual dry-erase whiteboards (WB1 and WB2) is also illustrated.

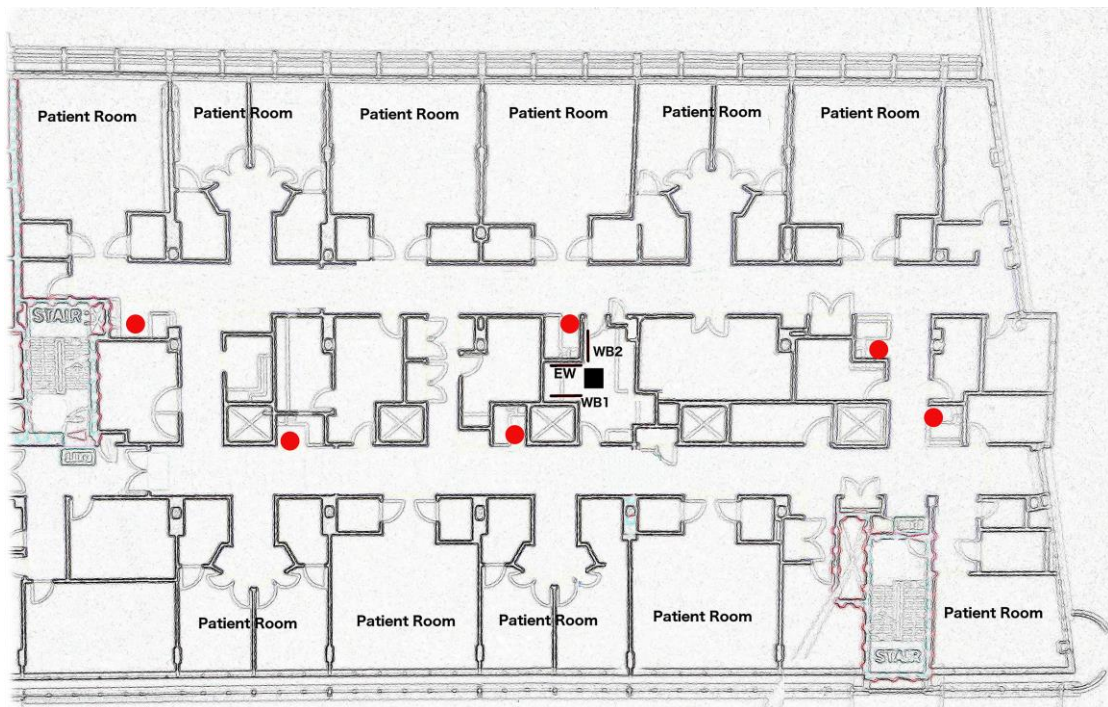


Figure 4: Overview of a general ward. Red circles indicate a workstation and the black square indicates the medical workroom. In the medical workroom WB1, WB2 and EPJB are indicated with black lines.

**Manual dry-erase whiteboards:** In addition to the EPJB, both study wards use two manual dry-erase whiteboards. The first whiteboard (WB1) is maintained to keep track of admissions, discharges and bed management (Figure 5) It supports the EPJB in identifying bed movements (i.e. changes that need to be made to accommodate new admissions). The second manual dry-erase whiteboard (WB2) is used as a duty roster to keep track of the nurses and doctors who care for patients on the particular ward (Figure 6). The EPJB does not include any information

displayed on WB2, however, it does include some of the information displayed on WB1, as summarised in Table III.

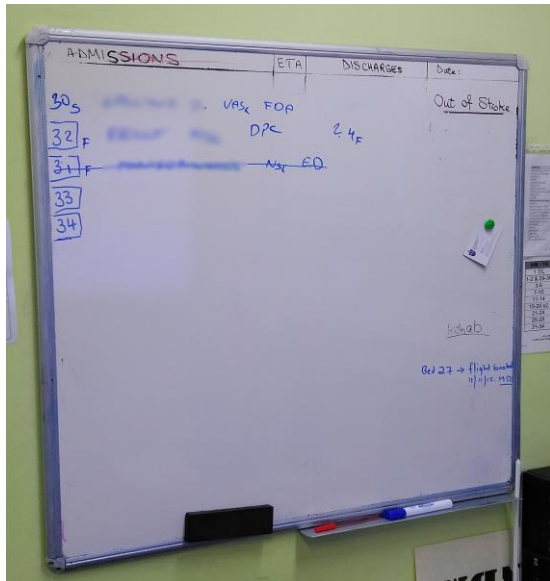


Figure 5: Photograph of manual dry-erase whiteboard 1 (WB1). WB1 is used to keep track of patient admissions, estimated time of arrival (ETA) and patients being discharged from the ward.

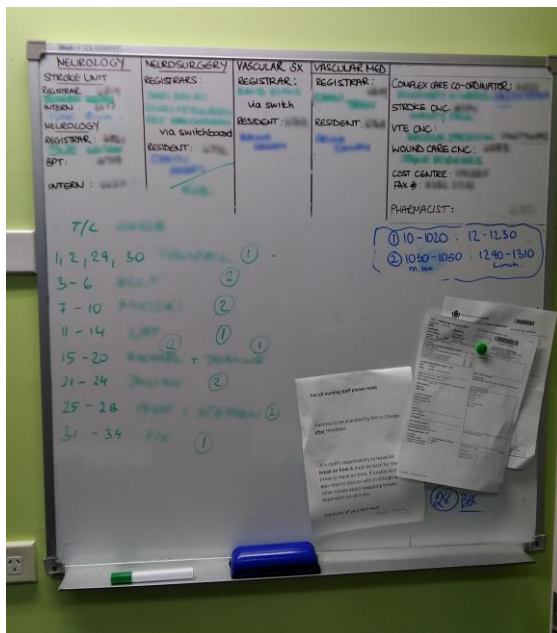


Figure 6: Photograph of manual dry-erase whiteboard (WB2). WB2 is used to keep track of staff and their patients.

As shown in Table III, the main benefit of the EPJB, over and above the manual whiteboards, is in discharge planning and bed management.

**Table III: Comparison between EPJB, manual dry-erase whiteboard 1 (WB1) and manual dry-erase whiteboard 2 (WB2) by information type.**

Information Type	On EPJB	On WB1	On WB2
<b>Key information about admitted patients</b>	Yes (Y)	No (N)	No (N)
<b>Duty roster</b>	N	N	Y
<b>Incoming patients</b>	Y	Y	N
<b>Bed management</b>	Y	N	N
<b>Daily discharges</b>	Y	Y	N
<b>Patient transport</b>	N	Y	N

### *Use of EPJB on hospital wards*

Overall, we observed very low use of the EPJB within wards, both at the central location and on the workstations. The majority of participants explained that they do not use the EPJB at all. One of the allied health staff members said “*We do not use the EPJB here*” and further expressed that “*There is no use in using the EPJB if no one else does*”.

When the EPJB was used, it appeared to be mainly used for administrative purposes, such as bed management. A small number of participants said that they use the EPJB for locating patients or for obtaining a quick overview of admitted patients by reviewing the *patient flow/waiting for* field in the EPJB.

In multidisciplinary meetings, despite the stated purpose, the EPJB did not seem to support information exchange or facilitate discussions during handovers. In LOS meetings, the staff used the EPJB to obtain an overview of patients admitted for more than 6 days. As for rapid rounds, variation in usage of EPJB across wards

was observed. In ward 2, the EPJB was used consistently during rapid rounds as a tool for accessing patient information (e.g. patient name, estimated discharge date). However, in ward 1 the EPJB was not used during rapid rounds, instead paper based patient lists were used to discuss patients.

### ***Barriers to adoption of the EPJB***

Based on our observations and interviews with staff, we identified four main barriers to the adoption and optimal use of the EPJB on general hospital wards.

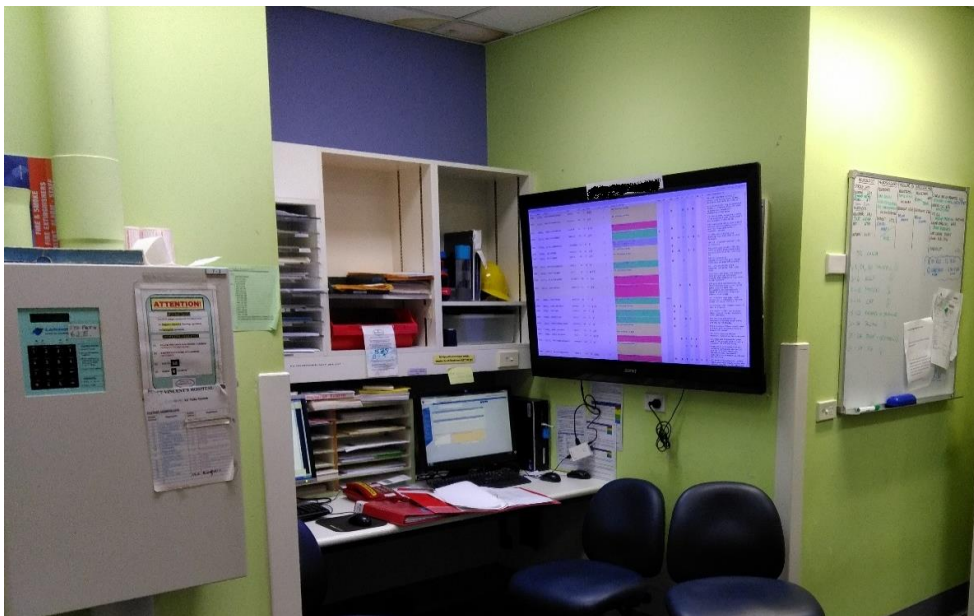
#### **Inappropriate location and display configuration**

The EPJB is located in the medical workroom situated in the center of each ward. The EPJB is positioned in the middle of the room in a corner adjacent to a workstation; however the room shape is not a regular rectangular (Figure 7). During observations it became apparent that participants found it very difficult to use the mouse to operate the EPJB. This was because the EPJB is placed to the right of the workstation and users are required to control the mouse with their left hand. Interactivity is a primary requirement, as not all patients can be displayed in a single screen view of the EPJB, making it a requirement for staff to scroll down to find a patient. As explained by a nurse on ward 1 “We don’t want to use the scrolling function”. Doctors also often occupy the workstation adjacent to the EPJB, making it difficult to access and use the EPJB during those times.

In addition to the interaction difficulties we observed, the screen size of the EPJB is not large enough to display all fields clearly. For example, the field showing the patient’s medical record number only displays 5 of the 7 digits. Similarly, the dates

for medical imaging are only displayed in full when one digit in length i.e. from the 1st to the 9th. The small text size used on the EPJB display was a complaint expressed by all participants during interviews. We also observed the EPJB to have a slow screen reaction time making it hard to quickly scroll through the patient list.

These issues with location, scrolling and small display have resulted in wards retaining WB1, which comprises similar information to what is available in the EPJB (Table I). Several participants stated that WB1 is much easier and quicker to use than the EPJB. A nurse said: “The information here (on EPJB) is too cramped up, whereas this (WB1) has clear cut information”.



**Figure 7: Location of the EPJB in the ward's medical room.**

### **Limitations in information timeliness, quality and customization**

Despite having an information intensive display, various staff groups found the information available on the EPJB to be insufficient. For instance, it was reported by a number of participants that the referrals on the EPJB contain limited

information, making it necessary for staff to also find a referral in other clinical information systems to obtain the information they need. Participants also explained that the EPJB is not used during MDT meetings, because the information displayed on the EPJB is not sufficient.

Although the EPJB is updated automatically every 15 minutes, several participants reported that this interval is not adequate, as situations can change quite rapidly. The result is that staff are hesitant to trust the information presented as up-to-date. For example, doctors explained that they do not view the green status symbol on the EPJB (indicating readiness for discharge) as a reliable indicator of a patient being ready for discharge. A nurse explained “We have to talk to people – the situation can change all the time”.

The nurses and doctors also explained that in most cases they only need information about their own patients, not all patients, as displayed on the EPJB. Using a paper patient list of only their own patients, typically including hand written notes beside each patient name, instead of the EPJB, facilitates easy retrieval of information. As expressed by a doctor “I have it all in my head” and “It (the patient list) contains all the information I need”. Another doctor explained, “What should I use it (EPJB) for – the information in *patient flow/waiting for* is information from me. There is nothing new on the EPJB for me – I know it already”.

### **Inconsistent information updating practices**

Despite having clear rules on responsibilities for updating particular types of information in the clinical information system (Figure 2), which then displays on

EPJB, we observed several inconsistencies in information updating practices. For example, although doctors are responsible for updating the estimated discharge date (EDD), NUMs were observed updating this information most of the time. As explained by one of the NUMs “Doctors are supposed to update the EDD, but they don’t. It’s just easier for me to do it, than to chase them around and make them do it”. Although all staff groups are responsible for updating *patient flow/waiting for*, in ward 1, nurses (evening shifts) updated this information. In ward 2, more consistency with established rules on responsibilities was observed as junior medical doctors updated EDD and nurses or care coordinators were observed to update *patient flow/waiting*.

Variability was also observed in the recording of referral information across study wards. The referrals shown on the EPJB are ordered via the clinical information system, but in ward 1, referrals are sometimes made verbally, when allied health staff members are physically present on the ward. In ward 2, referrals are consistently handled through the clinical information system, even if they are made verbally as explained by the NUM: “Sometimes a referral is done verbally but then I’ll ask them to do the referral in [clinical information system]”.

### **Limited shared understanding of the purpose of EPJB**

When asked about purpose of EPJB, we found very limited understanding among participants regarding the purpose of the EPJB. More than half of the participants reported that the purpose of the EPJB is to support administrative tasks (e.g. bed management), some believed that the EPJB is used to support discharge planning and patient flow, and only one participant said that the purpose of the EPJB is to

facilitate inter-professional communication. Staff perceptions of the EPJB appeared to be influenced by how the tool is actually used on the ward, rather than what the EPJB was designed to be used for. All staff groups viewed the EPJB as beneficial for other staff groups, not for them personally. For instance, doctors suggested that the EPJB is a good tool to support nurses during handovers, while nurses and allied health care professionals explained that the EPJB is useful for the NUMs and care coordinators to support their work.

A primary reason for the absence of a shared understanding was limited user engagement during the design and implementation of the EPJB. Participants reported that they had been given very limited or no training about the EPJB. One of the nurses explained that the EPJB had just appeared suddenly and staff were told that “This (the EPJB) is what we are using from now on”. Participants did not regard the EPJB as a tool that improved communication, but viewed it as just another system they have to cope with.

## **Discussion**

Despite increasing implementation of electronic status boards in inpatient settings, studies evaluating the use of these applications to date have been primarily undertaken in EDs and ICUs <sup>[17]</sup>. In this study, we explored barriers to adoption and optimal use of an electronic patient journey board in general acute wards of a large metropolitan public teaching hospital. We found that the EPJB, although intended to be a principal communication tool for multidisciplinary teams on wards, was not being used as intended in practice. We identified similar barriers to those identified in previous evaluations of ED systems: Issues in design and



configuration, a limited shared understanding of the purpose of the EPJB, and issues with information quality, timeliness and ability to customize the EPJB interface for specific user groups <sup>[21, 22]</sup>.

Interestingly, most of the barriers to optimal use we identified directly relate to the design of the EPJB and its alignment with work processes on the wards. Despite being a home-grown application, the initial design did not appear to take into consideration the dynamics of multidisciplinary team communication across wards and associated variances. For instance, the recording of referral information was different across the two wards, which had a direct impact on the accuracy of information displayed on the EPJB

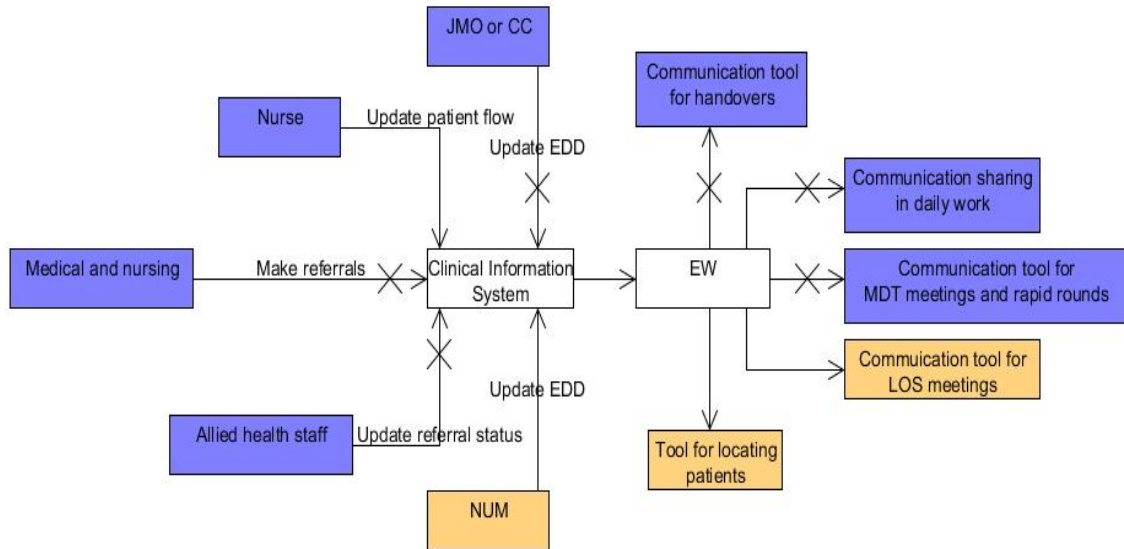
The journey board in its existing form is a static tool, as the content view is not customizable to suit the information needs of different user groups or multidisciplinary purposes. Inflexibility of electronic whiteboards has also been identified as a problem in previous evaluations of such applications in EDs <sup>[11]</sup>. Though some studies report use of touch screen capabilities, flexibility to generate personalized user based views remains largely limited in design of electronic status board applications <sup>[11, 22, 25]</sup>. An alternative to existing static and slow reactive screens could be the use of high fidelity touch screens, which could incorporate the option to have different views depending on who the user is at a given time. This solution would ensure that only relevant information is presented to specific user groups, and therefore a more manageable amount of information is required to be navigated through and processed. Consistent with a previous evaluation of an ED, the small size of the information displayed on the electronic whiteboard limited staff's capacity to quickly understand and use the content <sup>[16]</sup>. Removing redundant

information from the application would also provide more screen space to increase the size of the information displayed.

We found that staff on wards did not trust the information displayed on the EPJB to be accurate and up-to-date, a finding consistent with a previous evaluations of similar applications in surgical units and EDs [11, 19, 26]. This lack of trust most likely existed because of a limited shared understanding, insufficient training and no mutual agreement among staff on using and maintaining the EPJB as a single source of information. Despite EDs being more fast paced than acute ward settings, the lag in updating times was still an issue in this context of use. Reducing the information refreshing time on the EPJB from fifteen to five minutes may address some of the information timeliness issues we identified, however efficacy of quick refreshing is subject to the timely updating of information in the other clinical information systems that feed information into the EPJB. Therefore, enforcement of rules on keeping information up to date needs to be ensured across all hospital wards.

One of the unique contribution emerged from our study is identifying the variance in the use of EPJB on different wards of the hospital. Ward 2's information updating practices were more consistent with those defined in the business rules for the EPJB than those on ward 1 (see Figure 7). Despite this, staff on both wards perceived the EPJB as not very useful for supporting their daily work processes and overall use of the EPJB was very low. A possible reason for under-utilization of EPJB may also be technology fatigue experienced by the staff. Workers use a number of systems, in addition to the journey board. These other systems provide

them with similar information as the EPJB, potentially obscuring the distinctive value of using the EPJB.



**Figure 8: Updating and use of the EPJB in ward 1. Blue boxes represent use as per business rules and yellow boxes represent alternative or additional use on the ward. A cross indicates activities/missing links to the use as per defined business rules.**

In the study hospital, the EPJB was designed and implemented with limited input from end-users, which most likely impacted on the adoption and views of EPJB effectiveness. Previous exploratory studies have identified user involvement as a crucial factor for successful implementation of complex interventions like electronic whiteboards [20, 21]. To improve the use and uptake of the system, the organisation must identify how these electronic status board applications fits in with existing information systems, engage users early in the design process, train staff on how to use these applications to support their work processes, and more effectively communicate the additional benefit of using the tool. **This may involve using participatory design methodology, incorporating workshops, agile design and prototyping with users as co-designers [27].** Privileging the voice of diverse users of

complex is instrumental for their alignment with work as it happens on wards. Involving users in developing would also give staff ownership and a sense of belonging to the project along with establishing the unique value of the EPJB in the spectrum of information systems being used in the hospital.

This study was limited to one organisational setting with specific organisational practices, such as the execution of multi-disciplinary team meetings. As our principal observations and interviews were carried out in the medical workroom where the EPJB was displayed, researchers may have neglected to capture all uses of the EPJB among all teams and contexts. Future research using additional methods, such as structured observations could be used to investigate and compare the use of electronic status board applications across ward settings along with the use of other information systems by hospital staff. Further studies on team based technologies like EPJB in healthcare are also required to push the envelope of frameworks like unified theory of acceptance and use of technology (UTAUT) from their individual to team level acceptance of technologies<sup>[28]</sup>.

## Conclusion

The EPJB was not used as a communication tool among healthcare providers on the general acute wards of a hospital. Manual whiteboards were used on wards, in addition to the EPJB, to compensate for information not being available or accessible on the EPJB. Various barriers including those related to design and configuration, information timeliness and a shared understanding of the purpose of the EPJB, limited uptake and optimal use of EPJB by healthcare providers. These barriers are comparable to those identified in ED settings, despite the differences in

these contexts of use. Our findings suggest that regardless of the implementation setting, engaging users in the design and implementation phases of complex, information intensive and collaborative use applications like electronic status boards is vital to achieve successful implementation. Adoption of participatory design methodologies, which encourage engagement of users as co-designers, may be helpful in developing complex interventions like EPJB for wide scale adoption.

## **Conflict of Interest**

The author(s) declare that they have no competing interests.

## **Protection of Human Subjects and Animals in Research**

Ethics approval for the study was obtained from Human Research Ethics Committee at the participating hospital.

## **Acknowledgements**

We thank the hospital staff for their participation and collaboration in this study.

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## **Appendix A – Contextual Semi-Structured Interview Guide**

1. Can you briefly explain your role in the hospital?
2. How do you use EPJB during your daily work?
3. Did you receive any training on the EPJB?
4. In your opinion what is the main purpose of EPJB?
5. Are there any issues/problems with the EPJB when you use it?
6. Why do you think dry-erase white boards are still being used on wards?