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Digital Transformation of the ED-inpatient interface (EDii): Integration for Innovation

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What is the EDii?

- The EDii can be defined as the dynamic, transitional phase of patient care in which responsibility for, and delivery of care, is shared between ED and inpatient hospital services.

- The EDii is characterised by a complex interplay of patient, hospital and system factors

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PERSPECTIVE

Uniting emergency and inpatient clinicians across the ED–inpatient interface: The last frontier?

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Abstract

Unwell patients in the ED requiring inpatient admission must negotiate the interface between the ED and inpatient wards. Despite its importance and scale, this ED–inpatient interface (EDii) is poorly characterised. The aim of this paper is to clearly define the EDii and to describe its importance to (i) the patient: delays to admission and errors in communication across the EDii can increase adverse outcomes; (ii) the hospital: poor EDii function reduces hospital efficiency and effectiveness; and (iii) the healthcare system: half of all hospital inpatient admissions occur via the EDii and so EDii affects system-wide performance. The EDii can be defined as the dynamic, transitional phase of patient care in which responsibility for, and delivery of care, is shared between ED and inpatient hospital services. The EDii is characterised by a complex interplay of patient, hospital and system factors. A clear definition of the EDii and an understanding of its importance will assist future research and interventions to improve patient outcomes.

Key words: *ED–inpatient interface, EDii, emergency care.*

Introduction

Access to emergency hospital care is essential. However, the emergency healthcare system is currently facing considerable challenges because of the system-wide congestion and growing demand. Providing emergency care is challenging due to the high acuity, undifferentiated casemix and the highly skilled, resource-rich environments needed to deliver this care effectively.

Patients requiring inpatient admission are often particularly complex and it is these patients who must negotiate the transition from the ED to hospital inpatient care. This ED–inpatient interface (EDii) is a poorly defined yet critical operating system for the patient, the hospital and the healthcare system.

A patient is subject to the EDii from the ED decision to admit until they are under the care of the inpatient team and located in their destination ward. The EDii involves the transition between ED and inpatient care and has been identified as a period when errors in communication and confused accountability may lead to missed care or clinical errors.[1,2] In addition, the EDii is physically indistinct as patients at the interface may often be located in transitory spaces such as corridors or waiting areas that may be less well serviced with clinical equipment and facilities.[1,4]

The challenge may be compounded by cultural and attitudinal differences. ED teams are traditionally focussed on the initiation of appropriate care and timeliness of admission given their need to manage patient flow and to meet government time targets. Inpatient teams have competing priorities including scheduled admissions and fixed commitments such as clinics and operating lists. Inpatient teams may be understandably disengaged from ED time pressures and place greater emphasis on comprehensive formulation of a definitive diagnosis and management plan. These differing goals can create tension across the EDii and distract from patient care.[1,2]

The EDii has not been previously clearly and consistently defined in the literature. Partial definitions of the EDii have been published as listed in Table 1. Most of these definitions have transit or handover as their core principles and do not fully

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What is digitization?

- Digital transformation of healthcare is occurring rapidly across the world
- Queensland has undertaken a major digital hospital project with 25 hospitals planned over the next 2 years
- PAH was the exemplar site undergoing rapid digital transformation over a three week period in December 2015

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Pioneering digital disruption: Australia's first integrated digital tertiary hospital

Digital transformation has started in Australian hospitals

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Digital technology now underpins most industries; however, the health care sector (particularly in hospitals) has been slow to transform from traditional paper-based systems of care. In the United States, for example, federal legislation and financial incentives have facilitated the implementation of electronic medical records (EMRs);[1] but there are only a handful of advanced EMRs in hospitals outside the US.[2] The roll-out of a digital hospital includes an EMR system and other technical components, such as integrated digital vital sign monitoring and digital electrocardiogram (ECG) records. This transformation prompts revolutionary change in the way health care is delivered and monitored.

The enthusiasm for digital transformation in health has been tempered by previous failures, such as some of the unsuccessful EMR installations in the National Health Service in the United Kingdom.[3] Digital health care in Australia is well established in primary care and private specialist settings, but so far it has been chequered and controversial in hospital settings, with several independent reviews previously commissioned by government and other bodies.[4]

There are known adverse consequences and costs accompanying digital transformation of a hospital. These can include poor physician morale, increased frustration and reduced efficiency of care — particularly in the emergency department (ED) and outpatient setting.[5,6] Previous EMRs have also struggled to support traditional clinical workflows, with the American College of Physicians calling for EMRs to support the cognitive flow of physicians.[7]

However, there are many benefits to the installation of an EMR system, which include more efficient and effective care, clinical decision support and a reduction in adverse events.[8,9] There is no doubt that digital health care is the future. We describe here the challenging digital transformation of the Princess Alexandra Hospital (PAH) into the first integrated digital tertiary hospital in Australia.

Digital transformation

PAH was chosen as the exemplar site for a statewide EMR program and to become Australia's first tertiary digital hospital. It is an adult teaching hospital that delivers quaternary level care to a diverse, high acuity patient cohort. PAH has 6529 staff members, 833 overnight beds and cares for over half a million outpatients a year. The aim was to build an integrated digital hospital which provided care across the emergency, inpatient and outpatient settings. Vital sign monitoring and ECGs are digitised and delivered to the EMR via Wi-Fi for immediate viewing. Medications are the only significant component not included in this implementation and are planned for early 2017.

After an 18-month pre-implementation stage, the digital transformation of PAH was achieved using a big bang approach, with digital conversion occurring rapidly over 2 weeks.

Clinician concerns and experiences

It was a challenge to transform such a large, diverse organisation with a myriad of highly specialised workflows and a high acuity workload. The clinicians at our hospital had several valid concerns, the clear articulation of which influenced the course of the project.

Clinicians have had a difficult relationship with information technology (IT) projects — as evidenced by the problems affecting the Queensland health payroll.[10] It became clear that a traditional IT-led approach to the digital transformation of a large tertiary hospital was unlikely to be successful. Practising clinicians — rather than IT staff with clinical backgrounds — joined the leadership team to ensure that the project remained patient and staff centred. Clinicians had to drive the project rather than act as consultants. This clinical leadership enhanced the meaningful articulation of the potential long term benefits of an EMR — particularly, the promise of a rich database of clinical information that could be used to improve the care provided.

In addition, a large amount of training was required over a short period of time. Clinicians were concerned about the adequacy of the project-prescribed training and its logistics while maintaining the existing hospital function. The preparation involved 32 000 hours of training for 5384 staff. Traditional IT project-delivered web-based training alone was inadequate. Therefore, additional training, such as dress rehearsals using mock patients in clinical settings with the new technology, was organised to practise scenarios such as deteriorating patients and outpatient workflows before digitisation. This level of engagement with training required a brief reduction in elective surgical and outpatient activity.

Aim

- to assess the impact of digital transformation of the EDii on hospital process measures and clinical outcomes for patients requiring emergency admission to hospital.

Methods

- retrospective pre-post intervention study
- two 12 month periods were compared.
- standardisation of data elements between the two systems to enable comparison
  - state-wide implementation of new Emergency Data Collection System to enable comparison
  - clinical outcome data mainly from non-iEMR sources
- statistics
  - measures for each group compared using t test for parametric continuous variables
  - Mann Whitney U test for non-parametric continuous variables
  - eHSMR calculated denovo, p value calculated by comparing log of SMR ratios to a normal distribution

Measures

- Process
  - Total four-hour rule compliance
  - EDii four-hour rule compliance
  - Average ED length of stay
  - EDii average EDLOS
- Patient Outcomes
  - eHSMR
  - Raw Mortality
  - Cardiac Arrest within 24 hours of admission
  - Rapid Response team calls within 24 hours of admission

Group Characteristics

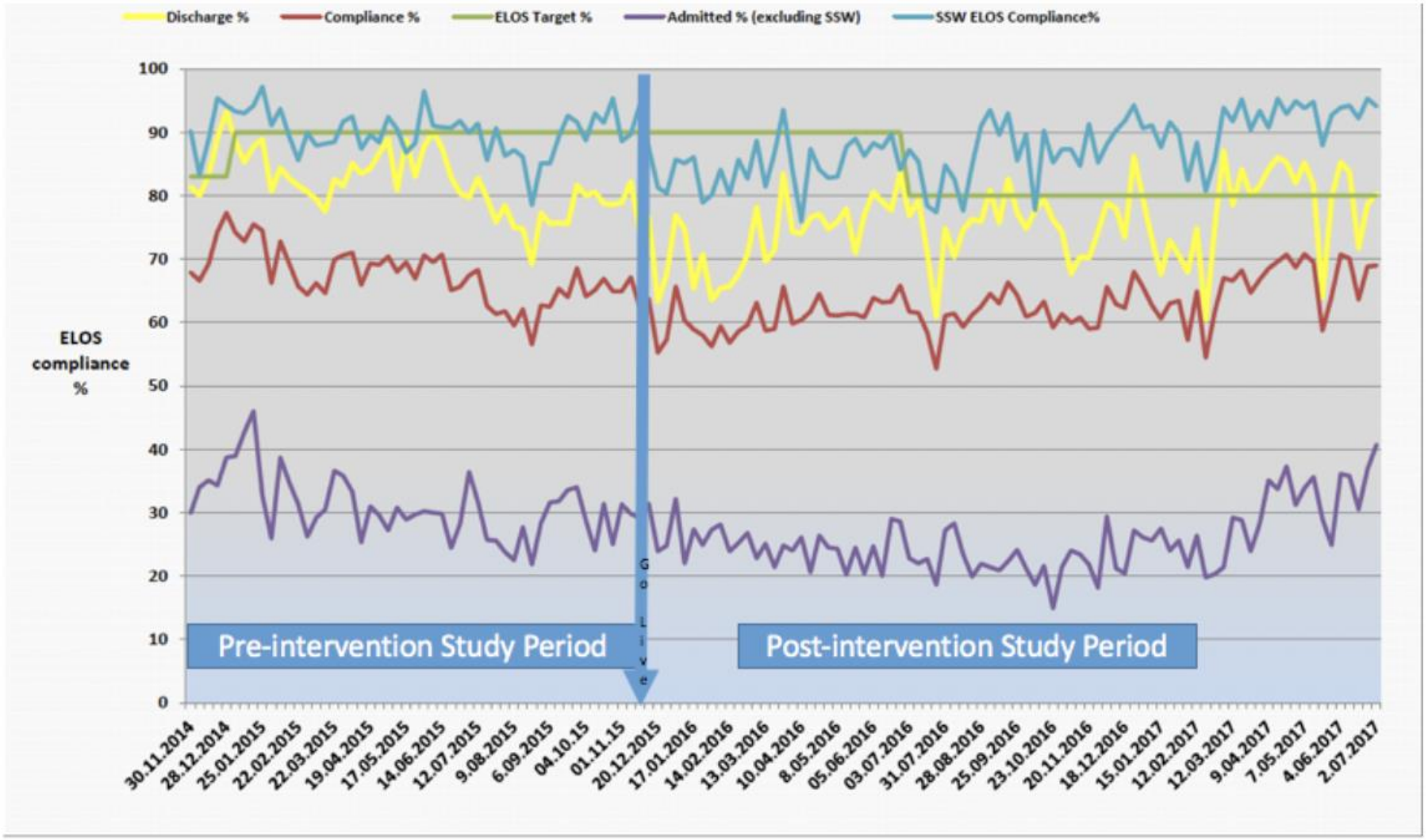
Table 2. Group characteristics for the pre and post intervention cohorts

		Pre-intervention	Post-intervention	p value
Patient Characteristics		N=62,374	N=60,359	
Age (mean years ± standard deviation)		47.01±20.29	46.73±20.18	0.035
Sex	Men	56.8%	56.8%	0.426
	Women	43.2%	43.2%	
Discharge destination	Home	41.5%	37.4%	<0.001
	Inpatient	30.5%	31.7%	<0.001
	Short Stay Unit	16.6%	19.3%	<0.001
	ED Mental Health Unit	6%	6.3%	0.02
	Other Hospital	0.9%	0.8%	0.05
	Left against medical advice or did not wait	4.5%	4.4%	0.76
	Died in the ED	0.1%	0.1%	0.76
Australasian Triage Scale	1	1.8%	2%	0.07
	2	20.6%	20.9%	0.13
	3	49.8%	50.3%	0.9
	4	22.2%	22%	0.39
	5	5.5%	4.7%	<0.001

Pre-intervention time period: 28/11/2014 to 28/11/2015
Post-intervention time period: 1/03/2016 to 28/02/2017

Process Results

ED LOS measures (hh:mm)	Pre-intervention		Post-intervention		p value
Number of patients	62,374		60,359		<0.001
ED LOS (median, range)	3:26 (0 to 46:19)		3:39 (0 to 23:57)		<0.001
ED LOS EDii patients (median, range)	5:54 (0 to 46:19)		6:38 (0:01 to 23:57)		<0.001
	%	N	%	N	
Overall 4HR compliance	67.2%	62, 374	62.0%	60, 359	<0.001
EDii compliance	31.0%	19, 044	23.7%	19, 115	<0.001


Discharge %
Compliance %
ELOS Target %
Admitted % (excluding SSW)
SSW ELOS Compliance%
ELOS compliance %
100
90
80
70
60
50
40
30
20
10
0
Go Live
Pre-intervention Study Period
Post-intervention Study Period
30.11.2014
28.12.2014
25.01.2015
22.02.2015
22.03.2015
19.04.2015
17.05.2015
14.06.2015
12.07.2015
9.08.2015
6.09.2015
04.10.15
01.11.15
20.12.2015
17.01.2016
14.02.2016
13.03.2016
10.04.2016
8.05.2016
05.06.2016
03.07.2016
31.07.2016
28.08.2016
25.09.2016
23.10.2016
20.11.2016
18.12.2016
15.01.2017
12.02.2017
12.03.2017
9.04.2017
7.05.2017
4.06.2017
2.07.2017

Outcome Results

Patient Outcome Measures for EDii patients	Pre-intervention		Post-intervention		p value
	%	n	%	n	
Rapid response team calls	0.5%	287	0.7%	399	<0.001
Cardiac arrest	0.008%	5	0.013%	8	0.27
Raw Inpatient mortality	1.9%	362	1.6%	307	0.016
eHSMR	0.78		0.71		0.14

Discussion

- Slowing of process measures
  - digital deceleration- particularly noticeable in the EDii patient group

- Reduction in mortality
  - potential decoupling of the 4-hour rule compliance/mortality relationship across a digital EDii
  - possibly due to increased availability of information across EDii or new models of care based on digital platform

Limitations

- retrospective observational study
- associations not causation
- confounding by other changes impacting on this complex adaptive system
- sample size
  - Even these large numbers not large enough to answer all questions (eg eHSMR)

Strengths

- real-world practice in complex adaptive system
- otherwise stable change environment at et the time of the study
- first to publish this type of data in fully digitized EDii environment

Conclusions

- Digitization was associated with slowing of process measures at the EDii
- This slowing was not associated with a worsening in patient outcomes at the EDii
- Larger and multi-site studies required once enough hospitals are digitized

- The understanding that digital deceleration will occur, but that with good patient outcome monitoring, worsening of key patient outcomes is not likely to occur now holds a key place in digital transformation planning.

FUTURE OF THE EDII AND TRANSLATION OF WORK

Future of the Digital EDii

Horizon 1: Better Access to clinical Information

- Better visibility of clinical information form previous admissions and attendances at other sites assisting ED clinical decision making
- Better visibility of information to inpatient teams while patient in EDii and transiting EDii

Horizon 2: Better care for groups of patients

- Expansion of process metrics to include clinical data to drive process change
  - Eg lab and medication data, digital vital signs, patient outcomes
- Real time streaming analytics instead of retrospective reports

Horizon 3: New and innovative models of care

- Machine learning and predictive analytics to predict deterioration and intervene at the point of admission before deterioration occurs

Contribution to body of knowledge and translation into practice

Digital transformation of the EDii has now occurred in eight Queensland hospitals. This accounts for over 500000 emergency attendances/year or 36% of all Queensland emergency attendances.

This transformation is planned to continue over the next two years to extend to over 90% of all Queensland hospital care.

The measures detailed in this study formed the basis for quality and safety monitoring of all of those digital transformations and continue to be monitored as part of ongoing safety, quality and efficiency assessment of EDii function.

The understanding that digital deceleration will occur, but that with good patient outcome monitoring, worsening of key patient outcomes is not likely to occur now holds a key place in digital transformation planning.

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