Portsmouth Hospitals NHS NHS Trust

University Hospitals Coventry and Warwickshire NHS NHS Trust

Impact of an electronic physiological surveillance system on hospital mortality at two large UK Hospitals

Peter Greengross[1], Paul Schmidt[2], Gary B Smith[3], Paul Meredith[2], David R Prytherch[2], Duncan Watson[4], Valerie Forde[4], Roger Killen[5], Mohammed A Mohammed[6]

*(**1**. Imperial College Healthcare NHS Trust; **2**. Portsmouth Hospitals NHS Trust; **3**. School of Health & Social Care, University of Bournemouth; **4**. University Hospitals Coventry & Warwickshire NHS Trust; **5**. The Learning Clinic Limited; **6**. School of Health Studies, University of Bradford.)*

Outline and context

Worldwide, thousands of avoidable in-hospital deaths occur due to inadequate vital signs monitoring and a failure to recognise and respond appropriately to deterioration [1 2 3 4 5].

This study involved the sequential rollout of an electronic patient surveillance system (EPSS) - VitalPAC - at two large (>1000 bed) UK hospitals (Queen Alexandra Hospital, Portsmouth [QAH] & University Hospital, Coventry [UHC]) to replace conventional paper vital signs charting.

Table 1: Summary data	**Portsmouth**		**Coventry**	
	2004 (Baseline)	*2010*	*2006 (Baseline)*	*2010*
Mean age adult inpatients	*62.6 (62.4-62.9)*	*66.3 (64.3-64.7)*	*63.0 (62.7-63.3)*	*64.9 (64.6-65.1)*
All spells (excl daycases)	*33983 (27959)*	*38694 (29676)*	*30878 (21771)*	*40483 (26241)*
Observed deaths (O)	*2168*	*1904*	*1648*	*1614*
Crude mortality rate (MR)	*7.75%*	*6.42%*	*7.57%*	*6.15%*
% change in crude MR		*-17.26%*		*-18.75%*
RR (95% CI) vs baseline		*0.83 (0.78-0.88)*		*0.82 (0.77-0.88)*
p-value cf. baseline year		*<0.001*		*<0.001*
Expected deaths (E)		*2301*		*1986*
Deaths avoided (O-E)		*397*		*372*

Problem and underlying causes

Safe care requires a "chain of prevention" (staff education, patient monitoring, early recognition of deterioration, timely escalation, and a prompt clinical response) [6]. Failure to deliver these interventions ("failure to rescue") is a cause of a large number of the estimated 12,000 preventable in-hospital deaths each year in England [7].

Strategy for change

Local audits at each hospital had shown that paper-based recording of observations was incomplete and often delayed, and the calculation of Early Warning Scores (EWS) error-prone.

We postulated that an appropriately designed clinical information technology system could improve the capture, charting, integration, interpretation and analysis of vital signs and the provision of decision support regarding subsequent clinical care.

Implementation

Prior to rollout of the EPSS, both hospitals had already established ICU outreach teams and revised their paper-based monitoring protocols to improve observation practice and the response to deterioration. The EPSS was initially developed on the Medical Assessment Unit (MAU) at QAH with multiple rapid-cycle software improvements made over an 18-month period. In May 2006, once nurses were confident that the system was reliable and safe, paper vital signs charting ceased.

Following successful, full MAU deployment, roll out across each site took place from 2008 onwards. The change involved all front-line nursing staff providing care for 324,157 patients ≥16 years on medical, surgical, and orthopaedic and trauma wards. Deployment was rapid (two to four wards per month, two weeks per ward from go-live to paperless working) and uptake excellent. By December 2009, hospital-wide deployment was complete at both sites.

Measurement of improvement

Total observations recorded per month were tracked as a measure of VitalPAC deployment.

Seasonally adjusted mortality rates (SA-MR) for 56 diagnosis groups that account for 83% of in-hospital deaths in England were measured in three main hospital specialties before, during and after the intervention (2004 to 2011).

Impact

During implementation of VitalPAC across QAH, SA-MR fell from 7.75% (2168/27959) in 2004 to 6.42% (1904/29676) in 2010 (p <0.0001). At UHC, SA-MR fell from 7.57% (1648/21771) in 2006 to 6.15% (1614/26241) in 2010 (p<0.0001) *(Table 1)*.

Before deployment, SA-MR was predominantly above the mean (QAH 30/47 [63.8%] months; UHC 44/57 [77.2%]), whereas afterwards, it was seldom so (QAH 5/37 [13.5%] months; UHC 2/27 [7.4%]).

In total we estimate there were 397 fewer deaths at QAH and 372 fewer at UHC after introduction of the EPSS, reducing in each specialty coincident with deployment of the system into its wards.

Lessons learnt

The key messages are:

- ★ Well designed clinical IT systems can improve patient outcomes, but they need to be reliable, easy to use and address important patient safety or Quality Improvement problems.
- ★ Involvement of clinical staff during concept development and early testing is critical.
- ★ Impact needs to be timely, measurable, and important to patients (better outcomes), staff (better working practices) and organisations (more effective and productive).

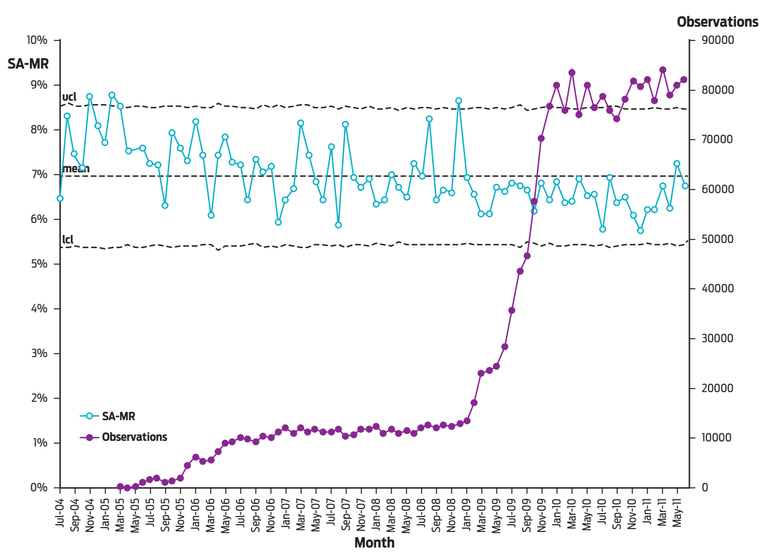

Figure 1: *Change in seasonally adjusted mortality rate (SA-MR), Portsmouth*

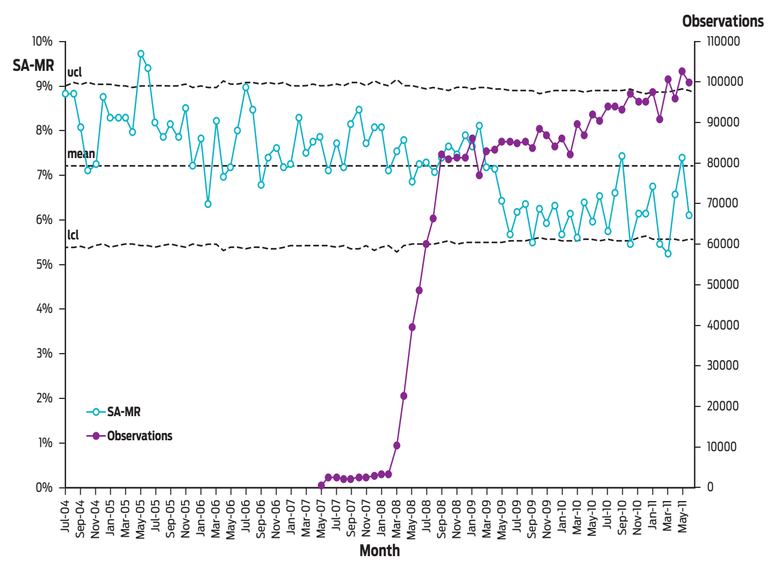

Figure 2: *Change in seasonally adjusted mortality rate (SA-MR), Coventry*

1 *National Confidential Enquiry into Patient Outcomes and Death. "An acute problem?" NCEPOD, London; 2005.* **2** *National Patient Safety Agency. Safer care for the acutely ill patient: learning from serious incidents. NPSA, London, 2007.* **3** *National Patient Safety Agency. Recognising and responding appropriately to early signs of deterioration in hospitalised patients. NPSA, London, 2007.* **4** *National Institute for Health and Clinical Excellence: Acutely ill patients in hospital: recognition of and response to acute illness in adults in hospital. NICE clinical guideline No.50. London; 2007.* **5** *National Confidential Enquiry into Patient Outcomes and Death. "Time to Intervene? A review of patients who underwent cardiopulmonary resuscitation as a result of an in-hospital cardiorespiratory arrest" NCEPOD, London; 2012.* **6** *Smith GB. In-hospital cardiac arrest: Is it time for an in-hospital 'chain of prevention'? Resuscitation. 2010;81(9):1209-1211.* **7** *Hogan H e al. Preventable deaths due to problems in care in English acute hospitals: a retrospective case record review study. BMJ Q&S 2012;21:9 737-745*

The Learning Clinic
Safer, smarter healthcare.