Improving patient identification in radiography with a systems human factors approach

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SUMMARY

Irradiation of the wrong patient or wrong site is a reportable adverse event for hospital radiology departments. This study applied a systems human factors/ergonomics (HFE) approach in an NHS trust to develop interventions across work system levels. Changes were implemented to address interruptions in radiography control rooms, to standardise identification checks and to run workshops to raise awareness of a systems approach for near miss reporting.

KEYWORDS

Healthcare, radiography, adverse event

Introduction

The primary aims of the project were to reduce patient identification adverse events and to increase near miss reporting in a hospital radiology directorate. A secondary aim was to raise awareness of a systems approach when reporting incidents. We applied a systems human factors/ergonomics (HFE) approach to develop interventions across organisational levels.

Radiological exposure of an incorrect patient or incorrect site in hospitals are rare yet widespread adverse events and are reportable to the regulator. The regulator's annual reports assign the majority of notifications to either "referrer error" or "operator error" categories. Implicit in this categorisation, whether intended or not, is the suggestion that the "root cause" of the incident is an individual's error. This is clearly at odds with contemporary human factors engineering and safety science research which view failure as frequently a *consequence* of system design rather than as solely attributable to human action (Karsh, Holden, Alper, & Or, 2006; Leveson, 2011; Svedung & Rasmussen, 2002).

System human factors/ergonomics (HFE) looks beyond a micro-setting to wider factors and includes principles from systems thinking such as: conducting analysis across work system levels, treating components as interconnected rather than isolated, and recognising that system behaviour is emergent – exhibiting processes and outcomes not foreseen by its planners (Waterson, 2009; Wilson, 2014).

Methods

Following a systems HFE approach interventions were made across three levels, summarised in the table below. An action research methodology was taken, so the initial focus, in the computerised tomography (CT) and plain film control rooms was directed by the management of the radiology directorate. Table 1 shows a summary of interventions.

Table 1: Summary of interventions

Level	Area of study	Intervention	HFE method/s
Micro	Interruptions in the CT control rooms. CT patient treatment recording	a. Access control installed on the doors. b. Changed phone directory app so CT control rooms were not the primary contact point. c. Improvement to the CT day list.	Structured field observations.
Unit	Patient identification procedure	a. Co-design of a standard operating procedure (SOP) b. Implementation of wristband barcode scanners in some areas.	Failure Mode and Effect Analysis (FMEA), document review, co-design workshop.
Organisation	Raise awareness of a systems approach to patient safety. Explore task trade-offs.	Programme of systems HFE workshops, delivered across the directorate. Scenario-based discussions of patient identification practice.	Scenario walk-throughs and discussions, teaching, risk exercises using SEIPS 2.0 and Ischikawa/fishbone contributory factors.

Micro level

Field observations were conducted in three separate workspaces (CT unit at the main hospital, plain film unit at the main hospital and a CT scanner in a small district hospital). Observations and discussions with radiographers highlighted that distractions and interruptions in the CT control rooms during the imaging process were an issue. Thus, structured observation sessions were conducted to record the number, type and severity of distractions in the unit's two CT control rooms. Data was collected across two periods, pre and post intervention with an equivalent duration of on-task time observed for each condition.

Two interventions were made to minimise interruptions and these are classified as micro level as they were targeted at two specific workspaces. The first updated a hospital phone directory app such that the control room telephone was not listed as the principal point of contact for the unit. The second installed access-control for the doors to the two CT control rooms so only radiography team members could freely enter.

Unit level

A Failure Mode and Effects Analysis (FMEA) was conducted for the CT imaging process. FMEA is a prospective risk analysis method that systematically considers hazards at different points of a process (DeRosier, Stalhandske, Bagian, & Nudell, 2002; Habraken, Van der Schaaf, Leistikow, & Reijnders-Thijssen, 2009). This was conducted with the support of two workshops comprising radiographers and researchers. The field observations were developed into a preliminary task analyses using a swim lane notation to indicate task by location (Jun, Ward, Morris, & Clarkson, 2009). At the first workshop these analyses were printed at large scale and developed and verified with the team. At a second workshop potential failures were identified for each step and a judgement of the relative frequency of failure and severity of harm was elicited from the participants.

Existing documentation relating to patient identification was reviewed and two main issues were identified: poor accessibility to this information for radiographers, and the length and format of the documents made them unwieldy to use. In response a simple patient identification standard operating procedure (SOP) was developed to work towards standardisation in line with user-centred design principles.

Organisation level

With the support of the trust, a series of systems human factors and patient safety workshops were run over a 6-month period for radiology staff across the four hospitals. These were designed and delivered by the research team with the following goals: a) to raise awareness of systems human factors/ergonomics when addressing patient safety, b) to encourage the reporting of near misses and, c) to raise frank discussions about the patient identification task and the new SOP. The workshops were a combination of presentation-led teaching and group work exercises. The first half of the workshop introduced the concept of a work system using the Systems Engineering Initiative for Patient Safety (SEIPS) 2.0 model (Holden et al., 2013). The second half of the workshop employed a simulation method in which staff worked in groups of three to walk-through (role play) a series of common scenarios using the SOP. Eight pre-developed patient identification scenarios were designed using A6 size script cards to raise situations in which identification was not straightforward.

Results

The micro level interventions were applied to one radiology unit in a single tertiary care hospital and preceded the wider initiative. The unit and organisation level interventions were incrementally applied across several units and hospitals within the same NHS trust.

Incidents and near misses

The start of the unit-level safety was associated with a four-fold reduction in mean monthly patient identification incidents (pre = 0.48, post = 0.12, $p = 0.03$). The interrupted time series analysis, which takes account of trend, did not however return statistical significance (rate ratio = 0.37, 95% CI 0.04 to 3.36, $p = 0.38$). A direct pre-post comparison showed that the intervention was associated with a significant increase in the mean number of monthly near miss reports (pre = 2.75, post = 7.46, $p < 0.001$). The interrupted time series analysis showed that the intervention was associated with an increase in the ratio of reports of 2.50 (95% CI 1.29 to 4.81, $p = 0.006$). This was as anticipated as the programme emphasised the value of reporting near-misses as an indicator of safety concerns.

Patient safety workshops

In total 156 staff attended the training across 16 workshops against an original target of 180 staff. 74% (116) were radiographers or sonographers, 10% (15) were radiography assistants and 16% (25) were managers or in administrative roles. During group exercises participants recorded factors that influenced their capacity to complete the imaging task.

Distractions

The mean number of distractions was lower in the post condition, pre = 4.91/10 minutes (SD = 3.26); post = 1.95/10 minutes (SD = 1.21). The Wilcoxon rank sum test reported statistical significance (W = 385, $p < 0.001$).

Discussion

Prior endeavours to improve safety in radiography have typically used narrow interventions (Flug, Ponce, Osborn, & Jokerst, 2018; Rubio & Hogan, 2015) which may be a reflection on resource constraints and a tendency for clinician-led projects to 'find and fix' localised, manageable problems. Our study followed broader lines of enquiry and viewed the radiography units as part of a sociotechnical system, in which formalised mechanisms of safety control interacted with group norms and embedded practice. Inherent in this approach was engagement with both radiographers practising technical work, and managers holding some influence over budgets and incident reporting responses. The organisational level intervention emphasised the value of near miss reporting in contributing to system safety which may explain the associated increase in reports. The safe provision of imaging across different modalities and physical locations is a challenge for many hospitals; this study indicates that a multi-level systems approach can reduce risk.

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