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Learning from incident reports in the Australian medical imaging setting: handover and communication errors

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Objective: To determine the type and nature of incidents occurring within medical imaging settings in Australia and identify strategies that could be engaged to reduce the risk of their re-occurrence.

Methods: 71 search terms, related to clinical handover and communication, were applied to 3976 incidents in the Radiology Events Register. Detailed classification and thematic analysis of a subset of incidents that involved handover or communication (n=298) were undertaken to identify the most prevalent types of error and to make recommendations about patient safety initiatives in medical imaging.

Results: Incidents occurred most frequently during patient preparation (34%), when requesting imaging (27%) and when communicating a diagnosis (23%). Frequent problems within each of these stages of the imaging cycle included: inadequate handover of patients (41%) or unsafe or inappropriate transfer of the patient to or from medical imaging (35%); incorrect information on the request form (52%); and delayed communication of a diagnosis (36%) or communication of a wrong diagnosis (36%).

Conclusion: The handover of patients and clinical information to and from medical imaging is fraught with error, often compromising patient safety and resulting in communication of delayed or wrong diagnoses, unnecessary radiation exposure and a waste of limited resources. Corrective strategies to address safety concerns related to new information

technologies, patient transfer and inadequate test result notification policies are relevant to all healthcare settings.

Advances in knowledge: Handover and communication errors are prevalent in medical imaging. System-wide changes that facilitate effective communication are required.

Problems involving the communication and handover of patient information are well documented [1–7], with inadequate communication identified as a contributing factor in up to 70% of hospital sentinel events [1,2]. Handover is a vulnerable time for patients, with an increased risk of discontinuity of care and adverse events [8–10]. Communication failures such as delayed, misplaced or forgotten results or inaccurate or inadequate handover of clinical information can result in adverse patient outcomes, including unnecessary delays in the diagnosis, treatment or communication of results and incorrect treatment [11,12]. Poor handover of information also results in considerable waste of limited resources [12].

Medical imaging is not exempt from these types of errors. There is growing evidence that medical imaging is prone to failures in communication, particularly the communication of critical and non-critical test results [13–15] and inadequate communication of patient information on the request form [16,17]. With increasing complexities of care, technological advances in imaging and electronic communication systems have seen new types of errors emerging [18].

Review of incident data informs patient safety and can improve the quality of care [19–21]. The Radiology Events Register (RaER) commenced in 2006 and it facilitates systematic data collection of incidents and discrepancies in all areas of medical imaging. In 2010, a multidisciplinary clinical interest group was convened to examine incidents involving handover and communication within the RaER database. The aim of this study was to identify where handover and communication incidents occurred within the imaging cycle [22], what human factors contributed to them and what strategies could be engaged to reduce the risk of their re-occurrence.

METHOD

Definition of handover

The definition used by the National Patient Safety Agency (NPSA) in the United Kingdom and adopted by the Australian Medical Association [23] was adapted to reflect the medical imaging environment. The revised definition is:

> Clinical handover involves the transfer of professional responsibility and accountability for some or all aspects of care for a patient or group of patients to another person on a temporary or permanent basis. Within medical imaging this involves specifically a two way information exchange that ensures the communication of relevant, accurate, timely and concise information to medical imaging from a referrer or other clinical staff and the communication of information from medical imaging staff, back to referrers and other clinical staff.

The RaER database

The RaER database allows voluntary reporting of incidents (adverse events and near misses) occurring within medical imaging in Australia and New Zealand. Information is collected via free text narratives from the following fields: what happened, what was the outcome, contributing factors and prevention and minimisation strategies. Demographic information about the patient and the practice setting are also collected. The system does not replace state- or hospital-based incident reporting systems and it is declared a quality activity by the Australian and New Zealand Ministers for Health, therefore information obtained is protected under their respective Healthcare Acts [24,25].

The Advanced Incident Management System (AIMS) is used to collect and classify the incidents [26]. At the time of analysis, the RaER database contained almost 4000 incidents from a range of data sources: staff working in medical imaging (mostly radiologists), medico-legal (ML) cases, Australian radiation regulatory authority (RRA) data and State Health Department (SHD) incidents. The incidents reviewed occurred between 2004 and 2010.

Clinical interest group

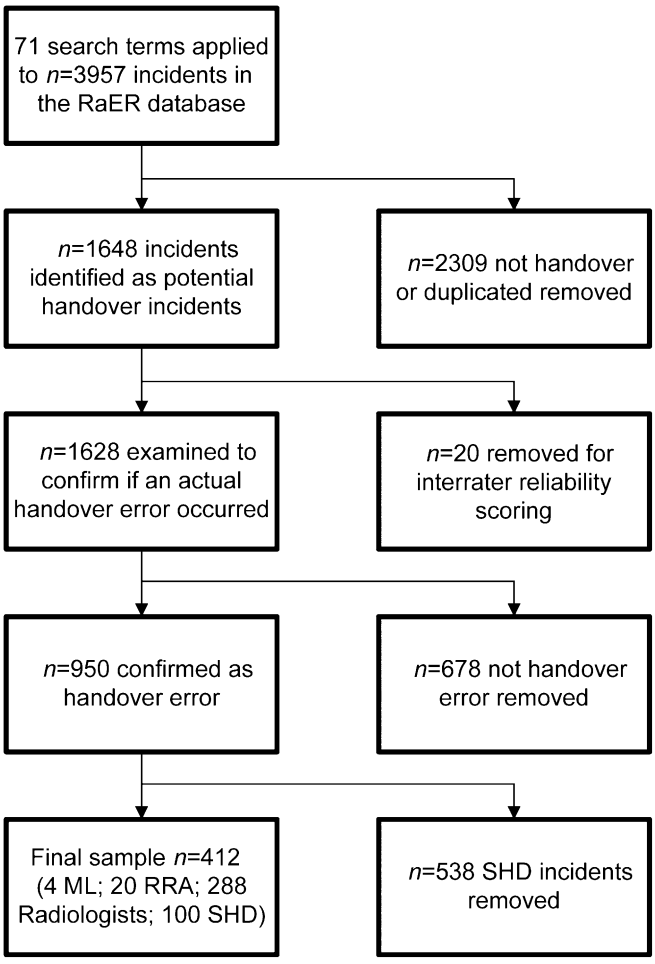
The clinical interest group contained health professionals with experience working in or referring patients to medical imaging and/or who had specialist knowledge in patient safety. Ethics approval for the

study was granted by a State Health Department—Human Research Ethics Committee.

Incident identification

Figure 1 summarises the selection of incidents for analysis. 71 search terms were defined by the group and used to search the narratives. Over 1500 (n=1648) potential handover incidents were identified following brief examination of the narrative, with 20 of those incidents being removed for interrater reliability testing. The remaining incidents were carefully read and analysed to confirm that the incident involved a problem with handover in the context of the above definition. Confirmed incidents (n=950) were classified according to (i) the stage of the imaging cycle [22] where the incident occurred and (ii) the specific nature of the incident. Incidents with insufficient narrative detail, duplicate reports and those that were not handover related were excluded (n=678). Incidents from the SHD (n=638) contained limited narrative detail because of privacy constraints on the release of their data, and only 100 of those incidents were retained in the data set. All remaining data sources were included in the analysis (n=412).

Figure 1. Summary of the results of searching and selecting incidents. ML, medico-legal; RRA, radiation regulatory authority; SHD, State Health Department.



Incident analysis

Within the clinical interest group three subgroups were formed, each assigned incidents to analyse according to their area of expertise. Education on how to deconstruct an incident using the Generic Reference Model [27] was provided to ensure consistency across the three groups. A thematic analysis was conducted on the responses for each data field and prevalence rates calculated as a percentage of the total number of responses obtained for that data field.

RESULTS

Source of incident and patient demographic details for the three most prevalent stages of the imaging cycle where incidents occurred and all their data combined (n=298) are presented in Table 1. The majority of incidents included in the analysis were reported by radiologists (70%). Inpatients accounted for just over half of the patient types (55%), and the majority of incidents were reported from a public practice setting (91%).

Problems occurred more frequently during patient preparation (34%); at the time of request for medical imaging (27%) and when communicating a diagnosis (23%) (Table 2). Examples of incident narratives from each of the most prevalent stages are included in Box 1. Detailed thematic analysis was conducted on the three most prevalent stages of the imaging cycle where incidents occurred (n=346). A small number of incidents from each of those stages contained insufficient narrative detail (n=48) and were removed. The remaining incidents (n=66) were not analysed owing to insufficient prevalence. Interrater reliability testing produced a kappa score of 0.7, indicating substantial agreement between two reviewers.

Patient preparation

Problems associated with patient preparation were inadequate handover of the patient (n=53, 41%) and unsafe or inappropriate transfer of patients (n=45, 35%) (Table 3).

Table 1. Demographic details for the three most prevalent stages of the imaging cycle where incidents occurred and their data combined (n=298)

Demographic details	Patient preparation *n* (%)	Request *n* (%)	Communication of diagnosis *n* (%)	All data combined *n* (%)
Source of incident				
Radiologist reported	84 (65)	62 (61)	62 (93)	208 (70)
State Health Department	46 (35)	26 (26)	4 (6)	76 (26)
Radiation regulatory authority	—	13 (13)	—	13 (4)
Medico-legal	—	—	—	1 (0)
Gender[a]				
Female	31 (52)	41 (56)	22 (46)	94 (52)
Male	29 (48)	32 (44)	26 (54)	87 (48)
Broad age band (years)[a]				
0–19	5 (11)	3 (5)	6 (14)	14 (9)
20–39	0 (0)	9 (14)	10 (24)	19 (12)
40–59	9 (19)	22 (34)	11 (26)	42 (27)
60–79	22 (47)	26 (40)	15 (36)	63 (41)
80+	11 (23)	5 (8)	—	16 (10)
Practice setting[a]				
Private	4 (5)	9 (16)	3 (6)	16 (9)
Public	73 (95)	49 (84)	48 (94)	170 (91)
Patient type[a]				
Inpatient	40 (78)	31 (63)	8 (19)	79 (55)
Non-inpatient	7 (14)	13 (27)	28 (65)	48 (34)
Other	4 (8)	5 (10)	7 (16)	16 (11)

[a]Information pertaining to these demographics is not available in incident narrative for all incidents.

Unsafe transfer of patients was common and posed considerable risks to patient safety, with patients being transported without appropriate equipment (*e.g.* oxygen or monitoring); by an inappropriately trained or qualified staff member (*e.g.* enrolled nurses transporting patients with patient controlled analgesia); in an inappropriate manner (*e.g.* clinically unwell patients transported in wheelchairs rather than in a bed); or the absence of trained staff at the receiving end to adequately care for the patient.

There was an adverse outcome in over three quarters of the patient preparation incidents (n=112, 80%), such as patient complication, deterioration or admission to a special care unit in 14% of incidents (n=19). Procedures were delayed in 13% of the incidents (n=18) and patient safety was compromised in 23% (n=32), highlighting unsafe and hazardous practices.

Request

Problems were identified with the content of the request form in over half of the request incidents (n=53, 52%) (Table 3). Having several parallel referral systems (paper-based, faxed and electronic) resulted in duplicate paper request forms for the same procedure arriving in medical imaging (sometimes days later) and a second procedure scheduled and in some cases, repeated.

Resources were wasted in almost one quarter of the request incidents (n=35, 24%), typically from imaging the wrong patient or repeated imaging. This resulted in

Table 2. Stage of the imaging cycle where handover incidents occurred

Stage of imaging cycle where handover incidents occurred	*n* (%)
Patient preparation	141 (34)
Request	112 (27)
Communication of diagnosis	93 (23)
Clinical question	30 (7)
Technical performance	11 (3)
Presentation/work-up images	9 (2)
Clinical action	9 (2)
Image interpretation	7 (2)
Total	412

unnecessary imaging and radiation exposure (n=31; 21%) and delayed imaging (n=27; 19%).

Communication of diagnosis

Delayed communication of a diagnosis (n=24; 36%) or communication of the wrong diagnosis (n=24; 36%) (Table 3) were the most common problems found, with information technology (IT) system failures or malfunctions (n=10, 34%) and interpretation errors by non-radiologists (n=11; 61%) being the most common problems identified.

Patient treatment, management or diagnosis was delayed in over half (n=42, 55%) of these incidents and included five incidents of delayed diagnosis or management of pulmonary embolus (PE), with patients sent home prior to the release of the final report having to be recalled urgently when the PE was confirmed. There was delayed diagnosis of fractures in 10 incidents as a result of interpretation error by non-radiologists in most cases (*e.g.* emergency staff or general practitioners).

DISCUSSION

Our examination and classification of incident data pertaining to the Australian medical imaging setting identified that incidents involving handover and communication are prevalent during transfer of the patient to and from medical imaging, at the time of requesting imaging, and during communication of the diagnosis. A summary of the key findings and recommendations are included in Table 4.

These findings are supported by the literature. A study conducted 20 years ago by Renfrew et al [28], which examined 182 "problems" in medical imaging, was presented at case conferences between 1986 and 1990 and noted similar problems to those we described. They stated that sources of error had not changed and that these included acquisition of an incorrect or incomplete clinical history, errors in perception and communication errors [28]. It would appear that the nature of errors in medical imaging have not changed over the last two decades, not as a result of healthcare professionals' incompetence but as a result of ineffective systems of care. The message in *To Err is Human* remains highly relevant: that preventing death and injury from medical errors requires dramatic, system-wide changes "that make it hard for people to do the wrong thing and easy for people to do the right thing" [19,29].

Box 1. Narrative examples for the three most prevalent stages of the imaging cycle where incidents occurred

Patient preparation

Patient with suspected abdominal aortic aneurysm (AAA) rupture was sent for a CT scan. The patient collapsed on the table and I had to a call code blue. One interesting aspect that I wish to bring to your notice is that the patient was sent for the scan unaccompanied despite having a high index of suspicion for AAA.

Request

A consultant physician ordered an upper abdominal ultrasound on a patient with query cholangitis/abnormal liver in the evening. The request was faxed to an unattended imaging department. No direct communication with imaging staff and no consultation occurred. The patient's clinical state deteriorated the following day and covering medical staff contacted imaging to enquire about the ultrasound, after noting the clinical deterioration and realising it had not been performed.

Communication of diagnosis

The patient was admitted with a history of unconscious collapse. CT angiogram scan of head was performed following referral by the Neurologist. The CT scan was performed in another section of the hospital. No communication occurred with the radiologist in the other section and the CT scan was not reported that day. The next day, the case was found on the picture archiving and communications system, resulting in delayed diagnosis of a cerebral aneurysm.

Table 3. Problems occurring within each of the three prevalent stages of the imaging cycle where incidents occurred

Problems within each of the three prevalent stages of the imaging cycle (%)	Number of problems (%)
Patient preparation n=*130*	
Inadequate handover *n*=53 (41)[a]	
Infectious state not handed over	15 (27)
Not performed/no handover provided	11 (20)
Inadequate/no post-procedure instructions communicated	8 (15)
Clinical history or condition incomplete/inadequate	6 (11)
Allergy not communicated	4 (7)
Inadequate/missing documentation	4 (7)
Pre-procedure requirements not communicated	3 (5)
Not advised of patient arrival	2 (4)
Incomplete/inadequate handover	1 (2)
Wrong patient handed over	1 (2)
Unsafe/inappropriate transfer *n*=45 (35)[a]	
No clinical escort	21 (35)
Transfer unsafe/inappropriate	13 (22)
Delayed transfer	6 (10)
No/missing documentation	6 (10)
Incorrect transfer policy	5 (8)
Excessive wait	3 (5)
Wrong patient/documentation transferred	3 (5)
Transfer policy inadequate	2 (3)
Equipment not provided	1 (2)
Request n=*101*	
Problem with content of request form *n*=53 (52)[a]	
Requested for wrong patient	24 (45)
Incorrect/inadequate clinical details	10 (19)
Wrong side requested	5 (9)
Illegible handwriting	4 (8)
Patient preparation not communicated	4 (8)
Allergy not documented	2 (4)
Request misinterpreted	2 (4)
No referrer details	2 (4)
Incorrect or inappropriate test requested *n*=14 (14)	
Incorrect/inappropriate test requested	8 (57)
Test no longer clinically required	3 (21)
Test requested by incorrect person	2 (14)
Did not check previous results	1 (7)

(Continued)

Table 3. (Continued)

Problems within each of the three prevalent stages of the imaging cycle (%)	Number of problems (%)
Duplicated request forms $n=12$ (12)[a]	
Two forms sent *i.e.* electronic and hard-copy	8 (67)
Same test requested by different team members/doctors	4 (33)
Communication of diagnosis n=67	
Communication of wrong result/diagnosis $n=24$ (36)[a]	
Interpretation error	18 (69)
Acted on interim report	3 (11)
Inadequate cross-checking	2 (8)
Incorrect clinical correlation	1 (4)
Perception error	1 (4)
Incorrect content report	1 (4)
Delayed reporting/communication of result/diagnosis $n=24$ (36)[a]	
IT system failure/malfunction/availability	10 (34)
Delayed communication critical test result	8 (8)
Inadequate communication/follow-up in radiology	4 (14)
Film not reported/inappropriate time frame	3 (10)
Inadequate resources in radiology	1 (3)
Report not available	1 (3)
Result not communicated	1 (3)
Problems contacting referrer	1 (3)

[a]Incidents may be classified with more than one problem type (*e.g.* a transfer was unsafe because no clinical escort and no documentation were provided) and the denominator may therefore be greater than or equal to the figure presented.

The question that remains to be answered is what system changes can be made in the provision of medical imaging services to address pervasive communication errors?

Patient preparation

Our study confirmed existing studies on the risk of intrahospital transfers [30] and identified that the preparation and transfer of patients to medical imaging was fraught with error. The reduced availability of personnel, equipment and monitoring away from the controlled environment at the ward can be detrimental to the patient [31,32] and the risk of complications increases for patients requiring critical care [33,34].

Our findings offer further illumination on the lack of communication between medical imaging and inpatient wards that severely compromises patient safety [35].

Much work is currently being undertaken to improve the quality and the content of clinical handover [1–3,12]; however, transfers to medical imaging have not been a specific focus, either because they are not considered high risk or because there is a lack of research in this area [36]. Standardised handover processes that are tailored to specific clinical contexts are supported in the literature and are now part of Australian National Safety and Quality Health Service Standards to improve clinical handover [37]. Our results provide evidence that a specific set of handover problems is prevalent in medical imaging and a need exists for health services to develop context-specific handover solutions to address them.

Another key finding of our study was the unsafe transfer of patients to medical imaging. For example, critically unwell or unstable patients were transported to medical imaging without a nurse escort and without appropriate equipment. Clinical handover strategies should be

Table 4. Summary of key findings and recommendations

Key findings	Recommendations
Patient preparation	
Inadequate handover of clinical information pertaining to patients	Adoption of and staff education on the Australian National Safety and Quality Health Service Standards to improve clinical handover [37]
Unsafe and inappropriate transfer of patients	Revision of handover and transfer policies to include the "five rights of patient transfer" (1) the *right* time (2) the *right* patient (3) the *right* equipment and documentation (4) the *right* level of supervision and (5) the *right* resources at the receiving end to adequately care for the patient
Request	
Problems with the content of the request form	Forcing functions for critical data should be embedded in all information technology systems
Incorrect or inappropriate tests requested	Clinical decision support tools that provide recommendations and protocols for appropriate imaging should be developed
Communication of diagnosis	
Delayed communication of diagnosis	Organisation-wide tracking systems that facilitate the distribution and receipt of results, with a method for flagging urgent and time critical results, are required
Communication of the wrong diagnosis	Policies regarding the release of interim, final and addenda to reports should be developed in line with technological advances

extended to incorporate standards on the safe transfer of patients, and transfer policies should address these risks. Transfer of patients should be carefully planned and include the "five rights of patient transfer" (Table 4).

Request

Request related problems included issues with the content of the request form and inadequate communication between referrers and medical imaging staff. Healthcare IT such as electronic ordering systems have the potential to enable a dramatic transformation in the delivery of healthcare, making it safer, more effective, and more efficient [38]. The ability of electronic systems to facilitate the timely exchange of information is critical; however, technological advances that are not well planned, tested and implemented can generate known and introduce new types of errors [18].

The study findings demonstrate that overreliance on IT systems to communicate accurate clinical information into medical imaging can be unsafe. Electronic referral and ordering systems must be reviewed and forcing functions for critical data introduced. Clinical decision support tools that provide recommendations and protocols for appropriate imaging should be built in to electronic request systems, thereby reducing the number of inappropriate or incorrect tests requested [39]. These could include checklists and automated mandatory fields that require completion before a request can be generated. These systems should not replace staff checking procedures but supplement them to reduce the amount of inappropriate or incorrect tests requested.

Communication of diagnosis

There is abundant information and research outlining problems with the communication of diagnosis, particularly critical test result notification and the subsequent ML implications for radiologists [13–15,40–42]. Our findings demonstrate that delayed communication of a diagnosis and communication of the wrong diagnosis were significant problems. Prevention strategies should be targeted at organisation-wide tracking systems to facilitate the distribution and receipt of results with a method of flagging and escalating communication of urgent and time-critical results. Policies regarding access to and release of interim (unchecked and unauthorised and, therefore, more likely to be subject to error) and final reports and

addenda to reports must be developed or reviewed in line with technological advances. If access to unauthorised reports is permitted, staff must be aware that they have an obligation to check the final report as this is the report upon which treatment decisions must be made.

Effective communication between referrers and radiologists is central to improving patient safety, and radiologists must be alerted to the interpretation of images made by other physicians so that errors and discrepancies are detected and corrected. Finally, referrers must ensure that they have actually received and acted on the results for all tests requested.

Limitations

The RaER database is a voluntary system so there may be biases in the types of incidents reported. Some incidents have limited detail and most are from the perspective of one person only. This does not reduce the significance of the findings in this paper. It does mean that the prevalence of incidents in medical imaging is much higher than our data set would suggest and that the results presented here may indeed be skewed. For example, there was only one incident where the content of the report was incorrect (4%) when in fact other studies that have explored this problem have found error rates of just over 20% [43]. The majority of incidents were reported from the public setting and therefore may not reflect those occurring in the private setting.

CONCLUSION

Incidents involving the handover of patients and patient information are prevalent in medical imaging. Although electronic systems have been touted as the panacea to solve all problems, this has not been the case as known error types have presented in new ways and new types of error have emerged. To decrease these incidents, it is important that system-wide changes to facilitate effective communication are made and that staff are educated about the importance of accurate and timely communication and handover. Reducing error is important to improve patient care, promote professional accountability, reduce unnecessary testing and prevent the waste of limited resources.

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