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NEW TECHNOLOGIES SUPPORTING PROFESSIONALISM, PATIENT EXPERIENCE, PATIENT REABLEMENT & PATIENT CENTRED CARE

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Abstract

This paper reports on an ongoing human factors study addressing the requirements for new technology to support patient experience, patient reablement, patient-centred care and staff professionalism at a post-acute care hospital. This is a preliminary and indicative study, and will be used to identify a case for technology transformation at the hospital. This research adopts a stakeholder evaluation approach to requirements elicitation and user interface design. Several early stage technology concepts have been proposed. This includes technology for both patients and nursing/care staff. It is anticipated that this technology will enhance patient experience, patient reablement and patient safety. Further, it will support professionalism and the provision of patient-centred care.

Introduction

Fairview Community Unit is a post-acute care service providing care for older adults. On average, patients spend four weeks at the facility. However, some patients remain for longer time periods and/or experience repeat admissions. In relation to patient ability, many patients require assistance with daily living activities. In addition, many have early cognitive decline and/or dementia. The care approach at the post-acute care service is underpinned by four clinical areas of focus as defined by the Mater Hospital (2015). These include: (1) patient safety, (2) quality, (3) competent and compassionate staff, and (4) patient experience (Mater Hospital, 2015). Overall, care activity is defined in relation to three high level patient goals: to promote patient reablement, to enable the safe and timely discharge of the patient either to their home or a long-term care setting, and to optimise the patient experience.

Patient experience spans the physical, social and emotional experience of the patient, while in hospital. It reflects the 'occurrences and events that happen independently and collectively across the continuum of care' (Wolf et al, 2014). Wellness concerns the biological, psychological and social state of the person (Havelka et al, 2009). Reablement encourages older adults to regain their independence and develop the confidence and skills to carry out daily activities by themselves, following a setback and/or health crisis. Theories of relationship centred care emphasise the importance of nurturing personhood and positive social relationships between patients and care-givers (Nolan, 2002). Teamwork and communication issues have been cited as root causes in adverse events in healthcare (Madden, 2008). As defined by Dixon-Woods & Pronovost (2016), patient safety depends upon open communication, trust and effective interdisciplinary teamwork.

New technologies are being advanced to support the needs of older adults living both independently and in assisted living contexts (Cahill et al, 2018). Such technologies provide diverse functions including: wellness reporting, health information management, entertainment, communications, telecare, activity monitoring, medication management and emergency alerting. Generally, this involves the use of a range of connected devices – for example, TVs, tablets, smart phones, wearables and environmental sensors (Cahill et al, 2018). In parallel, new technologies are being advanced for nurses and carers. These technologies are being used to enhance the assessment of patient acuity and for observations/ care task reporting (Frost and Sullivan, 2015). Potentially the above technologies might be adapted for a post-acute care environment, to enhance patient safety, patient experience, and staff professionalism.

Method

This research adopts a stakeholder evaluation approach to requirements elicitation and user interface design (Cousins, Whitmore & Shulha, 2013). This study involves both patients and staff. The first phase of research has involved documentation analysis, observations of staff (ten half days, elapsing over 5 weeks), interviews with nursing/care staff (N=20), and interviews with patients (N=11). Currently, the second phase of research is underway. Early stage prototypes of several new technologies have been advanced. Co-design/evaluation activities (Bødker & Burr, 2002) are being undertaken with nursing and care staff. This study has ethics approval from (1) the Institutional Review Board, Mater Misericordiae University Hospital, and (2) the Ethics Committee, School of Psychology, Trinity College Dublin (TCD).

Results

Care-giver Role

Although rewarding, the job of being a nurse and/or a care assistant is very demanding. Workload is high and professionalism is periodically challenged. Process compliance and patient reporting is closely monitored. All participants noted the importance of relating to patients and providing patient-centred care. However, there is often a conflict between patient reporting and providing direct person care to patients. Good teamwork/communication between nursing staff, between nursing staff and care assistants and between all staff and patient families, bolsters patient experience and patient safety.

Reablement

Reablement reflects a care philosophy as opposed to a formal clinical process. Nursing/care staff encourage patients (1) to sit out of bed, get dressed and move about, (2) to participate in daily activities to prevent boredom (i.e. listening to radio, reading, conversation, eating together and attending activities) and, (3) to maintain independence/ability (i.e. self-care, where possible). After spending time in acute care/post-acute care environment, many patients become dependent. Thus, to properly support reablement, it is necessary to intervene early in a person's care journey. That said, not all patients are on a path for reablement. Family co-operation in this process is hugely important. Often families are seeking long term care for their relative, and there is less of a focus on reablement.

Patient Goals

The primary goal for most patients is to return home. Other goals include: to get better and regain a sufficient level of independence so that they can remain at home, to adapt/cope with their new or evolving health situation and associated care needs, to maintain relationships/social contact with family and friends and, to have a positive relationship with nursing staff and care assistants.

Patient Experience

Participants described 'patient experience' in relation to the following aspects of their experience at FCU: (1) quality of their interaction with staff, (2) access to staff, (3) quality of care/treatment and associated care outcomes, (4) day to day life on the ward, (5) quality of food, accommodation and hygiene standards, (6) the inclusion of the patient's family in the care process (i.e. access to care information and involved in decision making) and (7), feeling safe.

Overall, (1) the quality of patient/staff interaction and staff professionalism was considered the most important dimension of patient experience. Interview feedback indicates that certain characteristics of staff/patient interaction are most valued. This includes: staff treating the patient as a person (using person's name, having a sense of what matters to them) and not just a set of symptoms, staff being warm/friendly, staff being responsive to the specific needs/care requests of patients, staff treating patients and their families as partners in their care, and staff treating patients with dignity and respect.

The patient day is structured around the meal schedule and nursing/care requirements. As reported by participants, a good day is characterized by friendly/warm interactions with staff, social contact with family (i.e. in person visits, texts and telephone calls), nice food and spending time outside of their room (i.e. walking corridors, visiting social areas, getting fresh air and a visit outside). Nonetheless, participants reported certain difficulties/pain points. This includes: (1) staying orientated (i.e. what day, what time, what is happening), (2) dealing with boredom and loneliness, (3) keeping in touch with family and friends, (4) coping with the challenging behaviour of other patients, (5) keeping motivated about the future, (6) obtaining information about their discharge status, (7) not getting dependent/institutionalized and (8) addressing room issues (i.e. problem with TV or wardrobes).

Patient Experience & Associated Processes

Several care processes directly address the patient experience. This includes:

- Intentional Rounding (i.e. hourly monitoring and reporting of patient situation)
- Dr Rounding (i.e. overall discussion of patient situation considering the perspective of the multidisciplinary team)
- Family meetings
- Daily activities (i.e. individual and group activities with activities co-ordinator)
- Patient risk assessment (i.e. monitoring of patient falls, pressure sores and wandering)

In addition, nursing and care staff encourage certain social and physical activities. For example, (1) eating together in the dining room, (2) physical activity (i.e. walking, exercise), (3) patient interaction with other patients in social areas and (4) participation from families/relatives (i.e. family visits and trips outside). As reported by participants, such activities promote patient wellness and enablement.

Patient Documentation/Reporting

All participants reported on the conflict between the requirement to document care activity (compliance), and providing direct personal care to the patient. Patient documentation spans recording of the patient's current health situation, medications, nurse rounding/observations, daily care tasks, assessments, discharge status and any incidents. Such documentation is largely a paper based process. A range of computer based applications are also used by nursing staff, but not care staff. Participants noted that it is often difficult to get real time information about the patient. To this end, nursing staff engage in certain paper based 'workarounds' to ensure real-time information is available about the patient. This includes: (1) summary briefing documentation carried by staff (daily updates), (2) rounding information pinned to doors, and (3) fall risks information pinned to doors and over beds.

Emerging Technology Concepts

The overall the approach is to develop technology which (1) promotes resident wellness, ability and reablement, and (2) is premised on supporting real-time communication between staff (nurses, care assistants and Dr's), between staff and patients and between staff and families.

In relation to nursing/care staff, the technology should support staffing and workload management issues. Specifically, it should enable nursing/care staff to: understand patient ability (cognitive, sensory, communication etc.), communicate relevant information concerning patient risk (safety awareness, fall risk, wander risk), obtain a real-time picture of the patient's care status and, support and monitor patient wellness and reablement.

In relation to patients, the technology should support communication with family members/friends, patient reporting, interaction with nursing/are staff, self-care, ability to control room/environmental settings, access to health information, access to entertainment content and the provision of information updates concerning patient meals and social activities. It was noted that any phone or tablet based application should ensure simple and intuitive interactions.

Several early stage technology concepts have been proposed. As indicated in Table 1 below, this includes technology for both patients and nursing/care staff. Figures 1, 2 and 3 below demonstrate some early stage prototypes.

Table 1: Summary of high level technology concepts

#	Technology Concept	Functions	End Users	Device
1	Patient information display	Displaying patient wellness information and precautions	All	Wall mounted display (not editable)
2	Nurse app	Reporting on nurse rounding, medication rounding, daily care tasks and patient updates	Nursing staff	Tablet
3	Nursing Console	Create and manage patient care plans, view patient information, record assessments info	Nursing staff	Desktop computer
4	Nurse station whiteboard	Communication of real time information concerning patient status	Primarily Nursing staff Also, Care Assistants & Activities Co-ordinator.	Whiteboard – wall mounted
5	Caregiver app	Reporting on care tasks	Care Assistants	Tablet
6	Patient app	Access to entertainment, reporting, meals information	Patients	Tablet and/or phone application
7	Family app	Access to information about patient	Family members	Phone application

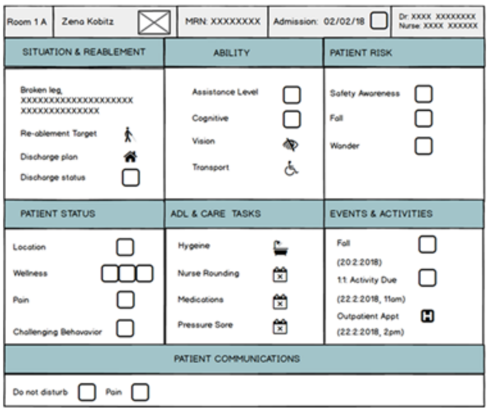

Figure 1: Wall Mounted Display

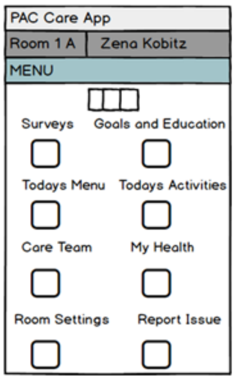

Figure 2: Patient App

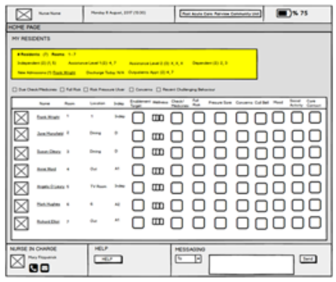

Figure 3: Nurse Tablet

Discussion

Patient experience is multi-dimensional spanning patient wellbeing, communication/interpersonal relationships and safety. In support of patient wellbeing and professionalism for nurses/care staff, new technology needs to promote quality communication (1) between staff, (2) between staff and patients and (3) between staff and families. Further, it should support the management of information pertaining to patient wellbeing (i.e. biomedical information, information about mood, behaviour, level of physical activity), reablement and safety.

As indicated in Table 1, new technology is required for both patients and nurses/care-givers. As a starting point, the goal of these technologies should be to improve existing information flows pertaining to both formal and informal care processes, so that patient care is enhanced and staff professionalism supported. The proposed technology for caregivers (i.e. wall mounted display, tablets) provides an opportunity to extend the existing philosophy of care, providing real time access to relevant information about the patient. Evidently, such technology should not be used to reduce the frequency of care contact with patients. One of the benefits of the wall mounted display is that it provides staff with key real-time information, thus providing more time for staff to interact with the patient (without a device in their hands). Nonetheless, tablets are useful from a reporting perspective. However, it is important that the use of such technology does not impinge on direct person contact (i.e. device in hand, staff with heads down/reporting care tasks using tablet and not engaging with the patient {touch, eye contact}). Patient specific technologies require careful consideration in relation to ease of use and adapting to age/condition.

It is anticipated that these emerging tools will enhance staff behaviour and activity in relation to providing patient-centred care and addressing patient safety. Further, insofar as such tools will enhance staff teamwork/communication and provide time savings in relation to accessing patient information and reporting care activity, these tools may indirectly support the management of staff stress and burnout. Nonetheless, technology is only one part of the solution. A positive patient experience and staff professionalism necessitates appropriate numbers of suitably trained staff. Further it requires the design of (and compliance with) care processes that directly address patient experience, patient wellness, reablement and patient safety.

Conclusions

Future technology should be used to support clinical/nursing care goals, integrating information flows across diverse care processes spanning medical staff and care assistants. Such technology should map to the four clinical areas of focus as defined by the Mater Hospital (2015), and prioritise staff and staff/patient communications. Patient reporting should consider the three pillars of patient wellness (i.e. biological, psychological and social). New technology affords the possibility for improved quality of care. Specifically, it may influence the behaviour and actions of staff - addressing care goals relating to clinical professionalism, patient care and patient safety. This is a preliminary, small scale and indicative study. It is anticipated that this study will be used to support a case for digital transformation at the Post-Acute Care Service.

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Systems Analysis Investigations and the Recognition of Human Factors to include Cognitive Bias in the Irish Healthcare System

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Abstract

Since 2013 the Health Services Executive (HSE) in Ireland has reviewed completed serious incident systems analysis[1] investigation reports to a) analyse the quality of the reports and b) to identify the themes of hazards in order to improve the organisation's processes for safety learning and to develop targeted safety solutions and improvements. The analysis of investigation reports has highlighted that most of the systems analysis investigations reviewed did not consider the possible contribution of human factors, (particularly the cognitive processes involved in clinical decision making) to the incidents. Analysis of the completed reports identified evidence of a number of possible cognitive biases that had not been identified by the original investigators. In this paper we discuss the need for systems analysis investigators to understand and apply basic clinical human factors concepts within the investigations they carry out.

Introduction

The maxim of "*Primum non nocere*", a Latin phrase that means "first, to do no harm'' is one of the principal rules of bioethics that all healthcare students throughout the world are taught. With a few notable exceptions, no healthcare worker goes to work to do a bad job or to do deliberate harm to a patient. However, adverse events occur every day in our health services. Rafter *et al.,* (2015) reported that large international reviews of patient charts estimate that between 4% and 17% of hospital admissions are associated with an adverse event and a significant proportion of these (i.e. one- to two-thirds) are preventable. Rafter *et al.,* (2015) also reported on research in hospitals in London and Scotland which demonstrated adverse event

[1] **Systems Analysis Investigation**: A methodical review of an incident which involves collection of data from the literature, records (general records in the case of non-clinical incidents and healthcare records in the case of clinical incidents), individual interviews with those involved where the incident occurred and analysis of this data to establish the chronology of events that led up to the incident, identifying the Key Causal Factors that the investigator(s) considered had an effect on the eventual adverse outcome, the Contributory Factors, and recommended control actions to address the Contributory Factors to prevent future harm arising as far as is reasonably practicable.
A **Contributory Factor** is a circumstance, action or influence which is thought to have played a part in the origin or development of an incident or to increase the risk of an incident. (Ref: HSE, Incident Management Framework, 2018).

rates of approximately 10% and a systematic review of eight chart review studies (from the USA, Australia, the UK, New Zealand and Canada) which found a median overall incidence of adverse events of 9.2%. A 2016 study to assess the frequency and nature of adverse events in Irish hospitals identified that the overall adverse event prevalence (i.e. the proportion of admissions associated with one or more adverse events) was 12.2% (Rafter *et al.,* 2016).

The investigation and analysis of incidents to identify, understand and address the causes of harm is a key element of quality and safety strategies and programmes in many safety critical industries including healthcare. Within the Irish health service, there is a requirement to carry out systems analysis investigations (or reviews) into adverse events or incidents that result in death or serious harm and where it has been identified that the incident was preventable and/ or avoidable for the purpose of '*understanding why an incident occurred and using this knowledge to improve safety*' (HSE Incident Management Framework, 2018).

As highlighted by Leistikow *et al.,* (2016) based on their experiences in the Dutch Healthcare Inspectorate: *"Incidents are not something in themselves; they are 'symptoms' of a larger problem, Instead of targeting the symptoms it seems better in the long term to target the 'causes of disease''.* One way to help with targeting the causes of harm or the causes of disease as Leistikow describes them, is to improve the organisation's processes for safety learning by analysing the quality of incident investigation reports and identifying where improvements are needed. A second is to look for the themes of hazards that cause the most harm to most people most of the time across investigation reports and to use this information to develop targeted safety solutions and improvements.

Since 2013 the Health Services Executive (HSE) has been reviewing completed serious incident systems analysis investigation reports submitted for analysis in order to do this. The analysis of completed investigation reports has been carried out by the National Incident Management and Learning Team (NIMLT) in the Quality Assurance and Verification Division of the HSE and builds on the work of McCaughan (2018) as part of Doctoral research being undertaken at Trinity College Dublin. The thematic analysis has assisted in the identification of trends of the types of incidents that are occurring (and often repeatedly occurring), the causal factors that lead to incidents and the individual contributory factors associated with the causal factors identified by investigations.

The analysis carried out over successive years has also highlighted that in most cases, the systems analysis investigations reviewed by NIMLT do not consider the possible contribution of human factors (particularly the cognitive processes involved in clinical decision making) to the incidents that occurred.

Human factors as it applies to healthcare has been described as 'clinical human factors' and as such seeks to explain the impact that the cognitive processes (including thinking, clinical decision making, stress and fatigue, team working, leadership, communication, situational awareness , individual personalities) of the staff at the 'sharp end' have on the care and treatments delivered to patients. Increasingly there is recognition of the importance of understanding and addressing clinical human factors as part of safety improvement programmes adopted in healthcare.

Despite the growing awareness of the need to understand clinical human factors in the delivery of safe care and treatment. There was limited evidence that this had happened in the investigation reports reviewed by NIMLT. This was particularly observed regarding the human factors that related to the thinking processes of staff at the 'sharp end' of the system and how these thinking processes might have influenced the particular clinical decisions and actions taken in the period leading to the incident being reviewed. Therefore while investigation reports may have identified human factors that were considered to have contributed to the incident such as fatigue, stress, communication issues or hierarchical structures within teams, by and large they did not consider cognitive processes associated with clinical decision making.

The finding that human factors are rarely considered within investigations is not limited to incident investigations carried out in the Irish healthcare setting. Graber (2005) noted that healthcare organisations have not viewed diagnostic errors as a systems problem. He observed that the analysis that is required to understand the cognitive processes and affective influences associated with diagnosis are difficult to study and quantify and to understand and suggested that; *''…root cause analysis, so powerful in understanding other types of medical error, is less easily applied when the root causes are cognitive.''*

In his publication, *The Field Guide to Understanding Human Error* (2006), Sydney Dekker highlighted that it is often easy to see what people could or should have done differently with the benefit of hindsight, in order to have prevented an incident occurring. However Dekker points out, that to understand human error we need to find out why things happened the way they did and why the decisions and actions taken by those present made sense to them at the time.

Wears and Nemeth (2007) also observed ''*We do not learn much by asking why the way a practitioner framed a problem turned out to be wrong. We do learn when we discover why that framing seemed so reasonable at the time*''. Croskeery *et al.,* (2013) note that clinical decision making is a complex process which can be categorised into two modes, either intuitive (sometimes described as automatic) or analytical. The intuitive mode of decision making is characterised by being fast, it is also usually effective. It is based on prior knowledge and pattern recognition. In contrast analytical decision making is slow, it uses all the evidence and fully compares alternatives, but it is resource intensive and it is also affected by stress and fatigue.

Cognitive biases or heuristics refer to the rules that intuitive or automatic decision making follow. The rules referred to are not the explicit type that tell us we can't drive through a red traffic light but instead take the form of deep ' tacit knowledge' i.e. where we reach a decision based on an intuitive knowledge and understanding of the problem and without having to go through the complex and slow process of analytical thinking. Heuristics are information processing short-cuts, sometimes described as cognitive rules of thumb, they are generally used where complex and exhaustive searching and processing of all of the information would be simply too slow, too demanding or not possible. Therefore heuristics are often used in the context of what James Reason calls ''flesh and blood'' decision-making or as Croskerry (2003) describes it ''*…the real decision making that occurs at the front line, when resources are in short supply, when time constraints apply, and when shortcuts are being sought.*'' It has been noted that without the use of heuristics it would not be possible to deliver care and treatments in complex and fast moving clinical situations. Croskerry (2003) and Kovacs and Croskerry (1999) observe that without the use of automatic decision making (including heuristics) 'emergency *departments would inexorably grind to a halt'.*

While the application of heuristics is essential in allowing us as humans to rapidly come to decisions in situations where analytical thinking may not be possible or appropriate, they can lead to cognitive errors and faulty decision making in some circumstances. Applying NIMLT's experience and Graber's view of the poor recognition of cognitive errors as the causes of harm in systems analysis investigations means that for those incidents where clinical human factors (particularly those that relate to cognitive processing and decision making) may have played a part in the events that unfolded, these investigations may not provide all of the learning and improvement opportunities that they could, particularly from the human factors perspective.

Methodology

A total of 79 investigation reports completed in 2017 from across the entire Irish healthcare setting including acute and community settings were reviewed by four members of NIMLT. These reviewers had knowledge and experience of conducting investigations and training investigators according to HSE investigation guidelines. The reports were divided among the four reviewers and were audited using a standardised audit tool which was originally developed as part of PhD research (McCaughan, 2018) to assess the quality of the reports and to collect data related to themes of causal and contributory factors. Since its original development, the audit tool had been periodically enhanced and further developed by the NIMLT reviewers based on the learning from previous use.

In addition one reviewer who was familiar with basic human factors concepts reviewed all 79 reports in order to identify common themes and issues across all reports which the four individual reviewers reviewing a sub-set of reports might not recognise. This information was then collated. The review of 79 investigation reports completed over one year indicated that 77% were undertaken using a systems analysis investigation methodology.

Results

From the review of the reports, there was evidence in a sub-set of reports that cognitive biases or heuristics may have been contributory factors. However it was difficult to be absolutely confident about this, as there was very little evidence within reports that investigators had probed or explored this possibility.

Despite this, the NIMLT reviewer(s) deduced evidence that was suggestive of cognitive bias in three of the 79 reports. Within those reports, where it was considered that there was evidence that cognitive bias may have been a factor, the possible cognitive biases were identified and are detailed in Table 1 below.

Table 1: Possible cognitive biases identified in three investigation reports completed in 2017

Cognitive Bias	Definition	Example	Deduced evidence from investigation
Authority bias	Is the tendency to attribute greater accuracy to the opinion of an authority figure (unrelated to its content) and be more influenced by that opinion (Milgram, 1963).	The co-pilot of an aircraft notices an oversight made by a senior pilot who is captaining the flight. However the co-pilot who is second in command does not doubt or challenge the commands of the captain made after this oversight, based on the belief that the captain has superior knowledge/experience.	The tests and assessments ordered and carried out on a patient; and the resulting formulations reached by junior members of the clinical team during different and successive episodes of care followed the same pattern as those ordered/made by senior clinical personnel during prior presentations to the hospital (when less clinical

			information was available).
Attribution bias	A cognitive bias that refers to the systematic errors made when people evaluate or try to find reasons for their own and others behaviour (Heider, F. 1958).	During a work related course over a two week period, you notice that a member of staff from another workplace is very quiet and withdrawn. They don't participate in any group discussions and they don't sit with the larger group during any breaks. You come to the conclusion that the person is either aloof and standoffish or very shy. Therefore you might incorrectly assume that the person's behaviour reflects his or her personality, and may not consider other situational factors that could explain their behaviour e.g. you might not consider that the person found the course very difficult or uncomfortable, or that the person was experiencing some personal difficulty and just did not feel like talking in the group.	All risk factors related to a patient's condition and presentation were not fully considered, as the clinical staff attributed the patient's presentation to one diagnosis over another in circumstances where the patient had a known dual diagnosis and where one of the diagnoses placed the patient at a significantly lower risk than the other. Consequently the staff's index of suspicion (for risk factors) appeared to have been lower than it would in other circumstances.
Confirmation bias	The tendency to search for, interpret, favour and recall information in a way that confirms one's pre-existing beliefs or hypotheses (Plous, Scott, 1993)	A person holds a belief that green eyed people are more artistic than people with other coloured eyes. Whenever they meet a person that is both green eyed and artistic, they may place great importance on this "evidence" that supports what they already believe. They may seek "evidence" that further backs up this belief while ignoring or	Successive tests and assessments ordered and carried out during different episodes of care related to the confirmation of the initial diagnosis being considered for the patient. No tests/assessments were considered /carried out during any of the episodes of care that might have led to an alternative

		discounting examples that do not support it.	diagnosis being considered. The initial diagnosis being considered/ pursued was subsequently found to be incorrect.
Premature closure	The premature closing of the decision making process before it has been fully verified (Mitchell 2013).	A student selects a topic for a research project. The lecturer gives a below average grade and comments that there was evidence of 'premature closure' in the project. Clarifying that the student stopped the enquiry too soon before they provided enough evidence that they had considered all of the literature provided and demonstrated knowledge of the research topic.	Patient attending for emergency review on a number of occasions with the same or similar presentation. The initial diagnosis arrived at was pursued at each subsequent presentation. The initial diagnosis being considered/ pursued was subsequently found to be incorrect.
(Loss of) Situational Awareness (SA)	SA is the idea of our mental picture of what is happening around us, as well as the implications of what is happening and what is about to happen (Mitchell 2013).	An experienced commercial flight crew, flying a route they have frequently taken before have a controlled-flight into terrain (CFIT) accident in which a sound airplane is flown into a mountain. On this occasion the crew were flying with a seriously ill passenger on-board, the weather conditions were very poor. The air accident investigation concludes that the crew lost track of their own position.	Patient's period of post - operative monitoring and management following major surgery was being carried out in an area not normally designated to be used for this purpose. Care generally provided in this area is for short term monitoring only. Demonstrable evidence that the patient's condition was deteriorating was not recognised by the staff providing care.

As noted, none of the reviewed reports indicated that the investigators had explored or analysed potential issues related to cognitive bias as part of their investigation. Only one report reviewed made explicit reference to the issue of potential bias as a possible contributory factor i.e. the report referred to a possible bias being applied by the treating clinical team in the treatment planning process for the patient. The type of bias identified was not described.

Additionally the report did not provide evidence that the issue of bias was discussed or explored with the staff who had been involved in the delivery of care to the patient; and if the staff involved had accepted that the clinical decisions made could have been affected by unconscious cognitive biases.

In this case, the NIMLT reviewers considered that there was evidence that the clinical team appeared to attribute the patient's presentation i.e. history, symptoms and behaviours to one diagnosis over another when the patient was known to have a dual diagnosis and where one diagnosis placed the patient at a significantly lower risk than the other. The report indicated that the original investigators considered that the appropriate risk assessments had not been carried out related to the second known diagnosis. Consequently the staff's index of suspicion (for the risk factors) appeared to have been lower than it would in other circumstances.

Discussion

Based on the work carried out by NIMLT over successive years of analysing incident investigations, it is our contention that there is a lack of understanding and appreciation among systems analysis investigators related to the role of clinical human factors as possible causes of harm in incidents occurring in healthcare. Rolfe (1977) suggests that *"The human observer sees the world in relation to his past experience. In consequence, what he perceives is partly determined by what he expects to see … An individual, therefore, has expectations regarding what is likely to happen in a frequently encountered situation."*

Henriksen *et al.,* (2003) stated that many investigators are unaware of the influence of outcome knowledge on their perceptions and reconstructions of the event. Given the advantage of a known outcome, what would have been a bewildering array of non-convergent events becomes assimilated into a coherent causal framework for making sense out of what happened. The authors state that if investigations of adverse events are to be fair and yield new knowledge, greater focus and sensitivity needs to be given to recreating the muddled web of precursory and proximal circumstances that existed for personnel at the sharp end before the mishap occurred.

Rasmussen's "Stop Rule" (Rasmussen, 1990) considered that investigators halt investigations as soon as they have found either a human error or a technical shortcoming that in their opinion sufficiently explains what has gone wrong i.e. *''In an analysis to explain an accident, the backtracking will be continued until a cause is found that is familiar to the analysts.''* The analysis carried out by NIMLT identified that while many systems analysis investigators expanded their consideration of the causes of harm to include the 'upstream' causes beyond human error or technical shortcomings described by Rasmussen (i.e. the organisational and institutional factors in the wider systems context that might have impacted on what occurred), they did not consider cognitive issues and the impacts of these on clinical decision making.

Based on the NIMLT analysis of investigation reports completed over one year it would appear that in at least three of the reports the "Stop Rule" was applied and the analysis of the incident was concluded prior to adequate consideration of the clinical human factors including the cognitive biases that might have existed and that might have contributed to what happened.

Rasmussen points out that the aim (of investigation) is to "*find conditions sensitive to improvements*". There is evidence that the cognitive processes that can influence clinical decision making are sensitive to improvement. This is most often achieved through cognitive debiasing or, as Wilson and Brekke describe it, *''mental correction''*. Croskerry *et al.,* (2013) observe "*Although a general pessimism appears to prevail about the feasibility of cognitive debiasing, clearly people can change their minds and behaviours for the better.*''

In order to understand and identify all possible causes of harm occurring in healthcare, i.e. those that are sensitive to improvements, an increased awareness and understanding of clinical human factors among investigators is crucial. Unless this happens, opportunities to improve systems safety for staff and patients will be lost.

NIMLT currently provides training in systems analysis Investigation methodology. The training provides trainees with a very basic overview of some of the concepts associated with clinical human factors. Based on the analysis of completed investigation reports NIMLT has recognised that an enhanced and dedicated training programme around clinical human factors is needed for investigators. To this end a training programme focussing on the introduction and understanding of basic clinical human factors concepts for systems analysis investigators was developed by NIMLT.

Further research will be needed to explore if the training enhances the capacity of investigators to consider and explore clinical human factors and the cognitive influences on clinical decision making as potential causes of harm in investigations.

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UNDERSTANDING OF HUMAN FACTORS - ERGONOMICS ISSUES IN INCIDENTS OF MEDICAL EXPOSURE TO RADIATION

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Abstract

This paper describes the role of ergonomics in the workplace, specifically healthcare and outlines the contribution made by the study of ergonomics to the specialities of radiology and radiotherapy. It describes the elements of a good system and using three examples of radiation safety incidents, identifies the outcome for the patient when a system fails.

Introduction

Ergonomics is the scientific study of how people interact with elements of a system. That is, the human side of everything done in industry, healthcare and all production lines (Salvendy 2012). In short, the equipment or process used in any system is only as good as the person operating it. Ergonomists aim to optimise an individual's wellbeing and improve overall system performance through data analysis and the application of evidence based theories, principles and methods of design. Ergonomics should incorporate and promote a holistic approach to system design in which the overall physical, cognitive, organisational and environmental factors are considered.

Ergonomists contribute to the overall design and evaluation of tasks, products, environments and systems in order to cater for the needs, abilities and limitations of the people working in the system. For example, an ergonomist will contribute to the design of office furniture to ensure people have appropriate seating in an effort to reduce the likelihood of a back injury and suitable equipment to limit eye strain from computer screens. The ergonomist may, upon assessment of an individual at their workstation, suggest additional tools to support that individual and improve their performance.

In healthcare, every system inevitably leads to a patient and safety is paramount. Ergonomics has an important role to play from the design of operating theatres, radiology departments and hospital wards to the implementation of efficient systems of work, timely treatment protocols and appropriate quality assurance programmes. The input of this profession is especially relevant considering the ever-increasing reliance on technology, the demands placed on healthcare staff and the necessity to provide a safe and efficient service to patients.

Nowhere is this more apparent than in the medical specialities of radiology and radiotherapy. Radiology uses medical ionising radiation to diagnose and sometimes treat disorders in the body. Radiotherapy involves the therapeutic administration of medical ionising radiation to patients, usually for the treatment of a cancer. In radiology, imaging procedures are often standardised and the amount of radiation exposure to a patient is justified on a case by case basis. In radiotherapy, treatment regimes are individually tailored to the patient to address their particular type of cancer and are dependent on multiple factors associated with that patient.

The management and administration of a radiation dose in both radiology and radiotherapy requires input from a variety of professionals such as doctors, medical physics experts (MPE), dosimetrists, radiographers and radiation therapists. It is reliant on the co-ordination of multifaceted radiation planning and delivery processes, and on the effectiveness and compatibility of increasingly complex technology (Moran and Wynne, 2016). The safety of staff involved in delivering the radiation dose and the patient receiving treatment is dependent on a smooth and efficient service and an assurance that the equipment and processes are fit for purpose.

When systems work well

Radiation protection is dependent on a number of processes that necessitate human interaction with equipment and complex technology. These systems include optimisation, robust risk management and an appropriate quality assurance programme.

The principle of optimisation

Optimisation ensures that medical radiation exposure is kept as low as reasonably achievable to obtain the required diagnostic or therapeutic outcome for the patient (MERU, 2017). It is dependent on staff being appropriately trained and qualified to operate the radiological equipment. Treatment regimes must also take into consideration patient factors such as size, weight and anatomical location of the treatment target to ensure radiation exposure of the patient is kept to a minimum (Wynne, 2017).

Good optimisation practice in radiology is evident in the development and implementation of optimisation protocols for common radiology procedures which serve to standardise practices and reduce human error. It is more difficult to standardise practice in radiotherapy as each treatment protocol is unique to the individual patient, however ensuring the MPE is involved in every treatment plan and all staff promote a system which supports the principle of optimisation will encourage a culture of radiation safety.

Risk management processes

Risk can never be eliminated but where possible it can be managed appropriately to limit the danger to staff and patients, which is the fundamental role of all risk management systems in healthcare. Reporting incidents and near miss events and analysing trends help to identify potential risks and inform local and national mitigation plans.

In the Health Service Executive (HSE), all incidents and near miss events are reported and managed locally in accordance with the HSE Integrated Risk Management Policy (HSE, 2017), and reported nationally through the National Incident Management System (NIMS). An open, transparent culture where events are reported and managed in a well structured, standardised and timely fashion is promoted and any learning to be generated from the event is shared. However, the incident management system is only fit for purpose if the information it gathers is accurate and the people using it are trained appropriately in assessing risk. Thus, this system of risk management is only as good as the person operating it.

Radiation safety incidents[2] can be potentially life changing for both patients and staff. Considering this, in addition to the local risk management framework, the HSE introduced a supplementary monitoring system through the establishment of the Medical Exposure Radiation Unit (MERU). This unit ***promulgated an incident reporting process nationally which operates alongside the local risk management framework to capture patient radiation incidents when they occur and ensure that they are managed appropriately (MERU, 2017). It also provides annual data on patient radiation safety incidents and near miss events to identify trends and help mitigate risks nationally.***

Engagement with MERU is not legally required and all radiological locations voluntarily support this additional reporting process and the extra work it entails, in order to promote best practice in radiation protection and safe outcomes for both patients and staff. The ongoing positive engagement between MERU and frontline staff in this regard is testament to the high priority given by all staff to patient radiation protection and the knowing that, despite best efforts, systems can still fail and adverse events can occur.

Quality assurance framework

Developing and implementing a quality assurance programme is essential to ensure that healthcare equipment is compatible, safe to use and fit for purpose. Quality assurance systems are based on key performance indicators which are designed to assist healthcare facilities demonstrate compliance with national standards and legislative requirements. These measures

[2]A radiation safety incident occurs when medical ionising radiation is administered to the wrong patient or when the delivery of radiation during a therapeutic or diagnostic procedure is different to that intended. Dose variation due to patient factors does not constitute a radiation incident and routine checking procedures are designed to catch potential errors before they occur. Issues identified outside of these procedures are considered near miss events. That is, potential errors identified and mitigated, resulting in no adverse outcome for patients (Moran and Wynne, 2016).

can be used as a foundation for audit or inspection and should be reviewed on a regular basis to support continuous improvement.

The role of medical ionising radiation in diagnostic and therapeutic medicine is expanding across multiple specialities and requires highly trained, vigilant staff to ensure safe practice and best outcomes for the patient. Safe systems of work are dependent on the experience and expertise of the staff delivering the treatment. The quality assurance framework is developed locally and approved and implemented by the MPE and/ or radiation protection advisor. Every quality assurance programme should include the assessment of patient dose and image quality, a proposed replacement date for each piece of equipment and evidence of compliance with legislative requirements.

Key performance indicators in a quality assurance programme include, for example:

- The appointment of a named MPE and/or radiation protection advisor.
- There is evidence of regular testing of equipment and anomalies had been addressed when identified.
- All equipment service records are available for inspection and up to date.
- Optimisation protocols for imaging equipment are available and approved by the MPE.
- Replacement dates are anticipated and planned for.
- There is documentary evidence of decisions made in relation to the continued use of equipment beyond the replacement date (MERU, 2017).

When systems fail

Medical ionising radiation is potentially dangerous to both staff and patients if managed inappropriately and the consequences of an adverse event can range from mild to catastrophic. An analysis of patient radiation incidents and near miss events reported on NIMS in 2017 highlighted a number of themes, including equipment and software issues, incorrect patient identification and poor referral practices (NRSC, 2017). Each of these issues has a robust, well established checking process in place to promote good practice. However every system depends on human interaction which, unfortunately can sometimes contribute to a failure in process and an adverse event which harms a patient.

What follows are three examples of patient radiation incidents reported in 2017. In all cases, appropriate checking systems were in place and used by staff but these processes failed and the patient received an unwarranted exposure to medical ionising radiation.

1. A patient presented to the nuclear medicine department of a hospital for a PET scan[3] of the kidneys. The radiopharmaceutical specific to highlighting activity in the kidneys was prescribed for the patient. The MPE made up the solution in accordance with the prescription and the department's protocol for administering intravenous medication[4], in the designated treatment

[3] Positron Emission Tomography (PET) Scan may detect early onset of disease before other imaging procedures. It involves the intravenous administration of a radiopharmaceutical to highlight areas of cellular activity which may indicate tumour growth.

[4] The protocol for administering intravenous medication necessitates the labelling of the syringe with the patient identification and prescription details to ensure the right person receives the right drug at the right time for the right area of treatment.

area which was securely locked. Unfortunately, the label printer in the department was shared with multiple users and located outside the secure treatment room, down an aisle and across a corridor in another area of the department. By the time the MPE reached the label printer with the syringe in hand, several more names had been printed and the MPE picked the wrong patient label for the syringe. Unfortunately, there was another patient in the department at the same time requiring a lung PET scan and as a consequence of the error, the patient requiring the renal scan received a radiopharmaceutical specific to the lungs. This error was only identified after the PET scan had taken place and the images were being reported on. The patient had to be recalled to the department to undergo the correct PET scan of the kidneys, which necessitated a further exposure to radiation.

The ergonomics of having a label printer that was shared with multiple users and located so far away from the treatment room where the radiopharmaceutical was developed undoubtedly contributed to the adverse event.

2. A patient presented to a radiotherapy department for treatment of a small carcinoma on the lip. This patient was elderly, in good health and independent. The treatment plan was developed and delivered in accordance with local protocols and procedures. Unfortunately there was an equipment failure at the first treatment and the patient received considerably more radiation than was prescribed. The outcome of this overdose was severe tissue necrosis of the mouth which impeded the patient's ability to eat and caused serious pain. The patient subsequently suffered a stroke which left them requiring full nursing care.

   This catastrophic event was caused by an equipment failure and illustrates the need to be vigilant in regards to the quality assurance of radiological equipment and the necessity to ensure that the software used is compatible.

3. A patient presented to the hospital radiology department for a CT KUB[5] scan which had been ordered appropriately on the computer system. The radiographer called the patient into the room and misread the order on the system. They inadvertently performed a CT scan of the brain and not the CT KUB requested. Once the procedure had been performed, the radiographer realised they had made a mistake and re-scanned the patient appropriately.

   Although there was no obvious harm to the patient from the incorrect radiation exposure, the incident occurred because of the momentary lapse in concentration by the radiographer.

Conclusions

The aim of ergonomics is to promote health and wellbeing in the work place and to ensure that every effort has been made to encourage a more contented working environment where the emphasis is on improving an individual's performance and promoting efficient systems of work.

In healthcare, better systems and happier staff inevitably lead to a more effective and efficient delivery of care and better outcomes for the patient. Risks can never be eliminated, especially when dealing with medical ionising radiation, but good work practices that are

[5] CT KUB – computed tomography scan of the kidneys, urethra and bladder.

standardised where possible, evidence based and supportive of the individual needs of the staff are to be encouraged.

Safe, effective and efficient practice is the responsibility of every healthcare employee who works with medical ionising radiation and adopting the discipline of ergonomics to identify avenues for improvement and to prioritise patient safety initiatives is recommended.

However, as every ergonomist knows, the fact remains that a system will only be as good as the person operating it.

"*Design is not just what it looks like and feels like. Design is how it works*."

- Steve Jobs

Recommendations

The following actions are recommended to reduce the human factors associated with system failures within the Irish healthcare system:

1. Ensure the label printer is located directly outside the radiopharmaceutical treatment room and that only those responsible for developing the medication have exclusive rights to use it.

2. All staff involved in the delivery of ionising radiation to patients must participate in ongoing training and demonstrate competence in risk management and quality assurance processes.

3. Encourage all staff to implement a 'patient safety pause', that is, to stop, take a moment to assess what they are doing and then resume their activity if it is safe to do so.

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INTRODUCTION TO THE EMERGING FIELD OF NEUROERGONOMICS -PROMISES AND CHALLENGES

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Abstract

Wearables are becoming ubiquitous in everyday life, since humans are willingly accepting the technological advancement of sensing technology, mainly for improving the daily routines and the overall well-being. This trend has opened a whole set of new topics in the applied psychology research, as the equipment for physiological sensing became almost invisible and it can be used outside the laboratory settings. Following this trend, the field of Human Factors and Ergonomic (HFE) became richer for the new discipline called Neuroergonomics. Neuroergonomics aims to investigate the brain functions and its relationship to work. It provides possibility to objectively quantify the worker's cognitive state, through investigation of the covert cognitive processes, as opposed to the classical ergonomics methods that mainly relied on the qualitative assessment and behaviourism research. Neuroergonomics is expected to especially benefit from the real-time data acquisition and processing, which can enable timely investigation of how different workplace parameters influence worker's cognition, thus providing a valuable input for the workplace optimization.

Introduction

Neuroergonomics is defined as the study of the human brain in relation to performance at work and in other naturalistic settings (Parasuraman 2003; Parasuraman and Rizzo 2006; Mehta and Parasuraman 2013). It integrates scientific disciplines of HFE and neuroscience while trying to exploit the benefits of each (Parasuraman and Rizzo 2006). The main aim of neuroergonomics studies is to enrich the HFE research by providing precise analytical parameters of brain functioning and behaviour in naturalistic settings (Mehta and Parasuraman 2013), rather than evaluating human performance through unreliable subjective measurements (Parasuraman 2003; Parasuraman and Rizzo 2008), which are mainly based on theoretical constructs (Fafrowitcz and Marek 2007). Additionally, dominant approaches in the HFE domain are behaviourism (i.e. stimulus-response psychology) and the cognitive approach in assessing the human performance, while the brain-related mechanisms were largely neglected (Mehta and Parasuraman, 2013). Advancement in neuroimaging technologies developed the field of cognitive neuroscience and in the latest years, these technologies were also considered by the HFE specialists (Mehta and Parasuraman, 2013). This is important because understanding of the brain processes in the naturalistic environments can lead to improvement of existing industrial processes design and to creation of more efficient and safer working conditions (Parasuraman 2003), consequently improving the operators' overall wellbeing.

Neuroergonomics already had a significant success in evaluating brain activity in the interaction with the automated systems, through the studies of dual-task performance (Ayaz et al. 2013), operators' vigilance (Warm et al. 2008), mental workload assessment (Mijović et al, 2017b), assessment of the concurrent physical and cognitive work (Maracora et al. 2009), transport research (Thibault et al. 2018), etc. Additional interesting field where neuroergonomics was successfully applied includes the neuroadaptive systems that serve for the mutual interaction between operator and the automated system, where both the human and the system can initiate the change in the level of automation if needed. Notably, the neuroergonomics also covered the field of manual work, where it was shown that simple change in task (Mijović et al. 2016), or providing workers with the frequent micro-breaks (Mijovć et al. 2017) can have a positive influence on the operator's attention level during the monotonous tasks. It was also recently shown that the neuroergonomics methods can be used for the on-line attention monitoring of the operators (Mijovć et al. 2017), which could later be implemented in one of the passive brain computer interface (BCI) systems (Zander and Kothe, 2011).

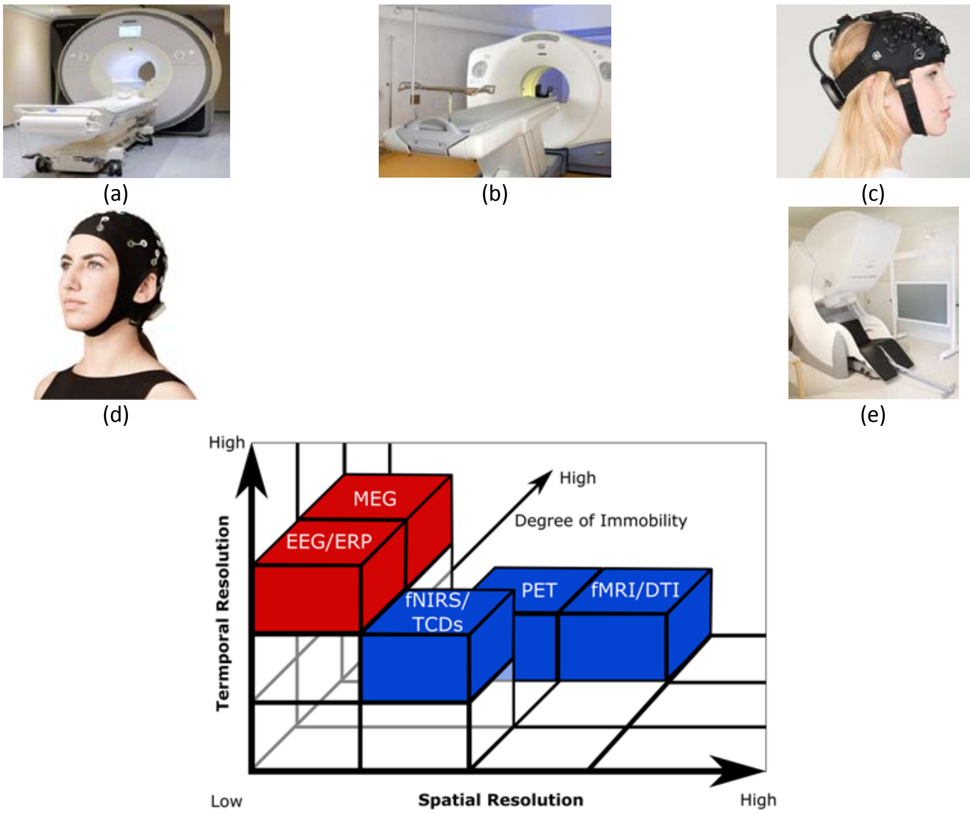
This work summarizes the neuroimaging techniques that are applicable in neuroergonomics studies and shows the pros and cons of each technique with the main focus electroencephalography (EEG) recording technique. It also briefly discusses the findings from the neuroergonomics studies performed with the EEG during the FP7-PEOPLE-2011-ITN project "Innovation through Human Factors in Risk analysis and Management (InnHF)".

Neuroimaging techniques in Neuroergonomics research

Extensive review of neuroimaging techniques applicable to neuroergonomics research has been recently published by Mehta and Parasuraman (2013). The neuroimaging techniques can be divided in two distinct groups according to their recording mechanisms: the one that use techniques for indirect metabolic indicators of neural activity, and the one that utilize the direct measurements of the brain activity (Mehta and Parasuraman 2013). First group consists of techniques such as functional magnetic resonance imaging (fMRI, Figure 1a), positron emission topography (PET, Figure 1b) and functional near infrared spectroscopy (fNIRS, Figure 1c). On the other hand, Electroencephalography (EEG, Figure 1d) and therefrom derived event related potentials (ERPs) belong to the neuroimaging techniques that directly measure brain activity (Gramann et al., 2011; Mehta and Parasuraman 2013a), together with the Magnetoencephalography (MEG, Figure 1e).

The main distinction between neuroergonomics and neuroscience is that former aims in investigating the brain functioning in relation to work and therefore when evaluating which neuroimaging method should be used for neuroergonomics study following three important criteria should be considered (Mehta and Parasuraman, 2013): (1) Temporal resolution, (2) Spatial resolution, and (3) The degree of mobility.

The temporal and spatial resolutions presents the ability of the recording device to discriminate between two data points in time and space, respectively, while the degree of mobility relates to the dimensions of the recording equipment and its usability for usage in naturalistic environments (Mehta and Parasuraman, 2013). Graphical representation of comparison of neuroimaging methods that are mostly utilized for neuroergonomics studies is depicted on Figure 1f.



(a) (b) (c) (d) (e) (f)

Figure 1: (a) – fMRI; (b) – PET; (c) – fNIRS; (d) – EEG; (e) – MEG; (f) comparison of neuroimaging methods utilized in neuroergonomics studies. Methods for direct observation of brain dynamics are depicted with red color, while the ones for indirect observation of brain processes (Blue); (Figure adopted from Mehta and Parasuraman, 2013).

Although fMRI and PET provide high spatial resolution, their low temporal resolution and big dimensions of recording equipment limits their usability for recording the brain activity in naturalistic settings (Gramann et al. 2014). Thus, from the first group fNIRS remains the single convenient technique for the neuroergonomics research in naturalistic setting due to it is lightweight, being consequently wearable (Ayaz et al. 2013). However, since fNIRS also suffers from low temporal resolution, which is in the order of several seconds, its use in dynamic naturalistic settings is still somewhat limited (Gramman et al. 2011). Regarding the investigation of sub-second brain processes the neuroimaging technique has to have a very good temporal resolution based on the direct investigation of brain processes. Two widely employed methods are EEG and MEG. However, the MEG is still contained solely to laboratory conditions due to the size of the recording equipment (Mehta and Parasuraman, 2013), thus leaving EEG as an unique method for investigating brain dynamics that follows participants' free movements (Gramann et al., 2011).

Electroencephalography (EEG) in Neuroergonomics research

EEG is a non-invasive recording technique, which principally measures electrical brain activity that originates in neocortex, using the recording electrodes that are placed on the subject's scalp (Gramman et al. 2011). Its high temporal resolution (down to the order of milliseconds) makes it suitable for the real-time investigation of brain dynamics in complex environments. Although, it suffers from low spatial resolution, the information which could be obtain from its frequency bands and ERP components can give rise to understanding of how diverse situations influence the brain processing.

Back in 1990, Parasuraman proposed the introduction of ERPs in ergonomics research and discussed about possible benefits of its application in various HFE problem areas. However, until recently the traditional EEG recording suffered from a long wiring between electrode cap and amplifier unit, which engender the artificial artifacts that degrade the signal quality (Debener et al. 2012). Additionally, EEG recordings usually required shielded dimly lit and sound attenuated room, which was one of the main preconditions for its recording, thus limiting its use in naturalistic environments (Gramman et al. 2011). These problems were recently overcome by the development of the wearable EEG systems, empowering its use in naturalistic and applied environments (Debener et al. 2012). This was mainly attributed to the miniaturization of the EEG amplifier, which can now be mounted on the participants head (Debener et al. 2012), thus reducing the cables length and eventually diminishing the artificial noise and electromagnetic interference which are caused by the long wiring.

Although EEG can nowadays be successfully applied in neuroergonomics research, the use of wet electrodes still limits its use in industrial settings, as they are uncomfortable and require preparation of the participants for recordings (Gramman et al. 2011). In order to overcome this difficulty, extensive work has been done on the development of the dry and even contactless electrodes (Chi et al. 2012). Additionally, clear momentum in the development of the consumer-based dry-electrode EEG devices can be seen in the form of e.g. emotive (www.emotiv.com), neurosky (http://neurosky.com), etc. However, the desired signal quality (low signal to noise ratio) with dry-electrode based EEG system cannot be achieved yet and they are still unable to reduce the movement artifacts, which are related to the relative movement of electrodes against the head surface (Chi et al. 2012). For that reason, reliable wearable EEG recording for neuroergonomics research can contemporary be made solely with the wet electrodes, still somewhat limiting its usage for the on-site industrial application.

Nevertheless, the operators' brain dynamics can nowadays be successfully investigated with wearable EEG in faithfully replicated workplaces, by simulating the work activity. For example, we conducted a series of the neuroergonomics experiments during the InnHF project in a replicated manual assembly workplace, while altering some of the work parameters and observing the influence of the workplace alteration on the attention level and the mental workload of the participants in the study. For investigating the brain dynamics we used a wireless EEG device SMARTING (mBrainTrain, Serbia) and we analysed the influence of different workplace parameters on the P300 ERP component modulation (as the P300 component amplitude is in direct relationship with the level of attention). In one of the studies we investigated the influence of micro-breaks on the worker's level of attention, where we showed that the frequent micro-breaks can have a positive influence on worker's attention (the P300 amplitude was consistently higher after the micro-breaks, Mijović et al. 2015). In another study we showed that instructing workers with which hand to start the manual assembly operation, instead of free choice, also elicited the higher amplitude of the P300 component, showing higher alertness of the workers (Mijović et al. 2016). We further investigated how do different work-related parameters are influencing the operator's mental workload, through analysis of the features that are related to the spontaneous brain oscillations, through the so called engagement index (Mijović et al. 2017b). In the same study, we investigated whether we can find the functional relationship between the operator's movements and the brain dynamics and we found that once the operator's engagement started decreasing the participants in the study committed more task un-related movements (explained in detail in Mijović et al. 2017b). Finally, we also proposed the framework for the operator's on-line attention monitoring, through investigation of the P300 component amplitude propagation over prolonged period of time (Mijović et al. 2017a). All mentioned studies showed how neuroergonomics can contribute to the more efficient task design and how neuroergonomics methods can be used for the real-time operator's attention monitoring.

Concluding Remarks

Although Parasaruman and Wilson (2008) modestly stated that neuroergonomics is not a revolutionary, but rather another step in HFE research, the growing body of neuroergonomics research refuted their statement. In fact, ever advancing technology supported neuroergonomics research and only fifteen years from its emergence, it is becoming one of the main directions in HFE research (Mijović et al. 2016). This expansion has also been confirmed in the past few years, since just two years ago the first neuroergonomics conference (biannual), with over 100 participants, was organized in Paris (France). This year a second international Neuroergonomics conference will be held in Philadelphia (USA). Additionally, in the past few years we have seen an increasing number of special issues in scientific journals that are dedicated to the Neuroergonomics research, e.g. there is an open access e-book (https://www.frontiersin.org/research-topics/3507/trends-in-neuroergonomics, Gramann et al. 2017) where the new trends in Neuroergonomics research were published. Further, an open call for the research topic: "Neuroergonomics: The Brain at Work in Everyday Settings" (https://www.frontiersin.org/research-topics/7089/neuroergonomics-the-brain-at-work-in-everyday-settings) can be found in an open access journal "Frontiers in Human Neuroscience". This trend is currently driving the establishment of neuroergonomics as the new scientific discipline and in the years to come it is expected that an increasing number of HFE specialist will also adopt the neuroergonomics methods as one of the standard tools for the ergonomics research.

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ASSESSING THE INFLUENCE OF PERSONAL AND ORGANIZATIONAL FACTORS ON SURGEON'S PERFORMANCE: A HUMAN RELIABILITY ANALYSIS (HRA) APPROACH

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Abstract

The primary objective of this study is the identification and assessment of factors that can influence surgeon's performance, and the integration of this knowledge into Human Reliability Analysis -HRA- approaches suitable for healthcare applications. The research methodology is based on mixed method approach which allowed achieving three main results. Firstly, through literature review, field study in robotic surgery, along with focus groups and individual interviews with surgical experts, the ad hoc taxonomy of Influencing Factors -IFs- for surgery has been defined; secondly, the ranking of these IFs, based on their criticality, has been achieved through questionnaire method; and thirdly, the degree of coverage of Error Promoting Conditions -EPCs- (IFs in the specific HRA technique - HEART - chosen for the application) in HRA application in robotic surgery has been investigated through HRA application using the designed taxonomy of IFs.

Introduction

The interest in the potential benefits of HRA applications, especially in surgery, is clearly emerging and increasing in recent years (Cuschieri, 2000; Cuschieri and Tang, 2010; Malik et al., 2003; Miskovic et al., 2012, 2013), and the benefits of transferring to healthcare services the most important proactive risk analysis methods, already implemented in industry, such as HRA, are fully recognized in patient safety literature (Cagliano et al., 2011; Lyons, 2009; Lyons et al., 2004; Verbano and Turra, 2010). The large majority of the studies tried to modify and adapt existing HRA methodologies to the clinical setting of interest. Nevertheless, the attempts to classify HRA methodologies in healthcare, e.g. in Lyons' study (Lyons, 2009), reveal that there is a lack of adequate knowledge, mainly about the rich spectrum of HRA techniques and methodologies, that currently affects HRA applications in the healthcare sector (Cagliano et al., 2011; Lyons, 2009; Lyons et al., 2004; Verbano and Turra, 2010). Therefore, there seems to be an urgent need of fostering theoretical knowledge and practical expertise on HRA in patient safety research and among healthcare practitioners as well. One relevant methodological aspect of the current way of implementing HRA in healthcare is that there are only few HRA studies that make use of Influencing Factors (IFs), i.e. those aspects of behaviour and context that impact human performance (Boring, 2010), although influencing factors analysis has been raised by some authors as one of the most interesting dimensions of HRA for healthcare applications

(Joice et al., 1998). This finding is not reflected in HRA theory and applications in the industrial sector, in which issues related to the modeling, selection, and quantification of IFs play a relevant role and represent a hot research line in this discipline since a long time. Some authors also highlighted that PSF (or IF) taxonomies incorporated in the most common HRA techniques have been developed and validated in industrial contexts, and as such are not fully applicable to the healthcare sector. In order to foster the diffusion of HRA in healthcare it is not enough applying and adapting to the healthcare context the existing HRA techniques originally designed for the industrial context. A deep adaptation and translation of these techniques to the healthcare environment has to be undertaken starting from the industrial knowledge about HRA theoretical and methodological issues. To this end, particular attention should be addressed to the selection and analysis of those PSFs that could shape the performance of healthcare professional (e.g. the surgeon) under different contexts, as they are generally constrained by the choice of the specific HRA technique.

Despite the limited number of reported HRA studies in healthcare, they are clearly and coherently focused on high risk and technology-intensive processes; there is a clear predominance of complex surgery and Minimally Invasive Surgery (MIS, e.g. laparoscopic surgery). The diffusion of the sophisticated technological equipment and devices will make the operating room an even more complex work environment for all the professionals involved, rising the need for more powerful and precise risk analysis methods. Additional clinical contexts where quality and safety could be improved thanks to proper HRA studies are robotic surgical contexts as new frontier of Minimally Invasive Surgery (MIS).

The methodological limitation about the investigation of influencing factors in surgery remains an issue of major concern for scholars. In this direction, the main research objective of this study relates to the identification and assessment of factors that can influence surgeon's performance, and to the integration of this knowledge into HRA approaches suitable for healthcare applications. Although human factors and ergonomics theory in healthcare gave a big contribution to the identification of factors that could influence surgeons' performance, to the best of author's knowledge there is no much literature available about validated taxonomies of Influencing Factors (IFs) for surgical contexts. The specific research objectives set for in this study are: i) Designing a taxonomy of Influencing Factors for surgery; ii) assessing the perceived impact of the validated IFs on Surgeons' performance. iii) Testing the proposed taxonomy of IFs and their assessed impact into an HRA application in surgery.

Research Framework

In order to achieve the research objectives, a research framework has been defined to fully understand which are the main concepts/variables within the area of investigation. As previously mentioned the target of my analysis is the surgeon performance, to investigate what are the Influencing Factors and the relative impact on it, and finally to test the new taxonomy of IFs through an HRA application in surgery. Although the long lasting experience of HRA application in industry gave a big contribution to IFs definition and taxonomies, the starting point of this study is the investigation of healthcare literature about the factors that may influence surgeons' performance. It means that a specific literature search and review need to be undertaken on different literature streams that are dealing with the same problem, i.e. the investigation of the human and organizational factors that influence surgical outcome. In this direction, patient's condition, and the technical skills and performance of the individual surgeon, for specific operations, are extensively studied in literature as the primary risk factors of surgical outcome (Crandall et al., 2014; Roques et al., 1999). Furthermore, with the recent advances in surgical technology, a number of studies focused on the association between surgical outcome and surgical technology (Parsons et al., 2014). Moreover, a number of studies tried to identify personal and organizational factors that influence the surgical outcome (ElBardissi and Sundt, 2012; Wong et al., 2010). On the same line, a relevant contribution comes from retrospective analyses, such as incident reporting analyses (Vincent et al.,2004), and the studies on Non-Technical Skills evaluation and assessment of the surgical team (Jepsen et al., 2014; Mishra et al., 2009; Undre et al., 2006a). Accordingly, this phenomenon has been already investigated from different perspectives that seem they don't interact each other. Wearing the theoretical lenses of HRA, this research project aims at exploring and modeling the Influencing Factors (IFs) for surgical contexts. Accordingly, the general research objective can be turned into four research questions: i) RQ1: "What are the Influencing Factors that can influence positively or negatively the surgeon's technical performance?"; ii) RQ2: "What are the IFs items to be implemented in IFs taxonomy for HRA application in surgery? iii) RQ3: "What are the most critical[6] Influencing Factors under different surgical settings?" iv) RQ4: "How to correctly interpret or adapt Influencing Factors taxonomies of current HRA techniques when applied in surgical context?".

The general Research Framework is graphically represented in Figure 1, which describes the context, the main variables and their mutual relationships, and where the gray area sets the boundaries of the research scope. Coherently, the investigation of the influence of patient conditions, surgeon's and other surgical team members' performance, and of the surgical setting on the overall surgical outcome is out of the scope of this study. The RQ2 and RQ4 are strictly connected to the application of HRA in surgery, as shown from Figure 2: HRA application aims at quantifying the human error probability (HEP) of one or more tasks of a surgical procedure in a specific surgical setting. In most of the HRA techniques the HEP is modulated by the presence of Influencing factors (IFs) chosen from the entire list of them which the specific HRA technique considers. As mentioned before all the taxonomies of IFs adopted by the existing HRA techniques were developed referring to the industrial or transport contexts. Indeed this study, introducing the IFs taxonomy developed and validated for surgical context, aims at investigating to what extent these factors are captured by the existing taxonomies when adopted in HRA studies in surgery. Answering this research question is an attempt to contribute to filling the main knowledge gap in HRA application in healthcare.

Methodology

Given the nature of this study, it is acknowledged that the research needs to follow the HRA theory and methodological approach. Following HRA approach, many scholars argue that IFs taxonomies of HRA are developed to be suitable for a specific application area (Kim and Jung, 2003). Accordingly, this study aimed at deeply exploring the surgical environment where the unit of analysis, the surgeon, is working. The research methodology follows a multi-phase and mixed method approach.

[6] "Critical Influencing Factor" means influencing factor able to modify (limit) the technical performance of the surgeon.

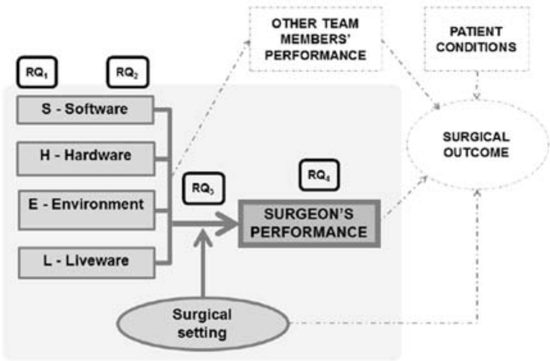

Figure 1: General Research Framework

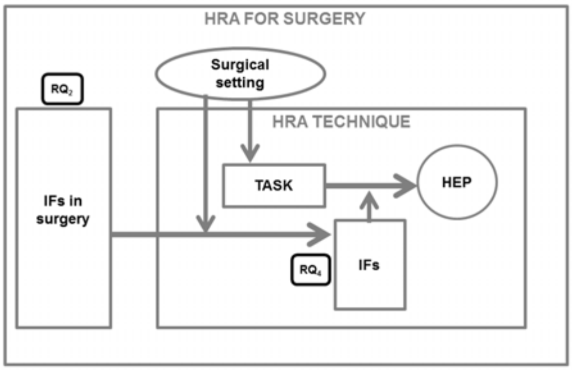

Figure 2: Specific Research Framework for RQ2 and RQ4

In particular, four main steps compose the research process, and different methods (Literature review; Field study; Focus Group/individual interviews; Questionnaire method, Modified HEART technique for HRA application) have been used in each phase depending on its specific objectives.

Since the complex nature of contemporary social science, there is an increasing consensus around the benefits that were identified in the literature about the mixed-methods approach to address different research settings and problems (Johnson et al., 2007). It fits with the need of deep adaptation and translation of the well-structured HRA discipline in industry to a new context of application, which has to be deeply investigated. In particular, in this research, a exploratory qualitative research approach was adopted to explore any aspects of the interaction between the human and the technological elements in surgery, addressing the first two research questions, namely RQ1 and RQ2. Then, a quantitative approach was used to assess the influence of those factors according to the experts' judgments. Furthermore, the experimental phase of HRA application consists of qualitative and quantitative steps, as expected by the selected HRA technique, i.e. HEART (Williams, 1985).

Results

Design of a taxonomy of influencing factors in surgery

The approach taken in this phase consists of two steps. First, to answer the RQ1 a preliminary list of IFs categories was set by means of literature review covering the most common surgical settings. The purpose of the literature search was not a systematic review, but the identification of the highest number of applicable personal and organizational factors already investigated by scholars in healthcare literature. A subsequent research step aimed at validating, and possibly expanding the preliminary list of IFs categories through direct observational activity during real surgical operations. Once the IFs categories have been identified, to answer the RQ2 an exploratory study was conducted through focus group and individual interviews of surgeons in Italy and in Denmark, thanks to the collaboration with the Management Engineering department of the Danish Technical University in Copenhagen. Twenty-one IFs items resulted in the validated IFs taxonomy and they are described in Onofrio et al. (2015;2017).

Assessment of the impact of IFs on surgeon's performance

The second phase of the research addressed the third research question (RQ3), leading to the quantification of the impact of IFs on surgeon's performance based on a structured experts' judgments elicitation. The practical aim is to assess the absolute weight of each IF according to the subjective perception of surgeons. Looking at HRA discipline in industry, the choice of the Influencing Factors requires the identification of those factors that negatively affect the human performance. This step of HRA application is highly subjective, thus dependent on the judgments of the assessor(s). In healthcare, the choice of these factors becomes even more critical due to the high number of contingencies and a wide variability of the contexts. In order to answer to the RQ3, a questionnaire was designed to facilitate the collection of consistent responses from a large number of surgeons. Data clearly shows a strong impact of noise issues - noise and ambient talk and verbal interruptions - on surgeon's performance (and surgical outcome as a consequence) under mini-invasive settings. These factors are perceived less influential by surgeons when referred to an open surgery context.

Testing the proposed taxonomy of IFs and their assessed impact into an HRA application in surgery

Through the selection and modification of an existing HRA technique for application in surgery, the applicability of the proposed taxonomy of IFs in the context of an HRA study in surgery was finally tested. This research phase directly answers RQ4; in this regard, it aims at satisfying the need for a deep adaptation and translation of HRA techniques to healthcare environment and therefore it is a way to fill the gap between healthcare and industrial literature on HRA. It also contributes to the spread and consistent application of HRA in healthcare. A modified version of HEART method (Williams, 1985) is applied to the robotic surgical Radical Prostatectomy procedure (Galfano et al., 2010) in Italy (at Urology Department at Niguarda Ca' Granda Hospital, Milan - Italy). The detailed findings of the study are described in Trucco et al. (2017). According to the findings, the EPCs traditionally used in HEART method are not able to fully capture and explain the relevant organizational and personal IFs in a surgical context. This result confirms the importance of adapting HRA methods to the healthcare sector and adds original detailed information on what are the most relevant factors that should be captured by an HRA method when applied to surgery in particular.

Conclusion

This study contributed to the diffusion of HRA applications in healthcare, in particular in surgery, where the diffusion of advanced technological solutions adds further complexity and, consequently, possible new error pathways. It contributed to the deep adaptation and translation of these techniques, originally designed for the industrial contexts, to the healthcare environment. In particular, the development and the adoption of an ad hoc taxonomy of IFs in HRA for surgery contributes to deeply understand safety priorities (in terms of personal and organizational factors) of surgical procedures in the context of a complex socio-technical surgical theatre. Furthermore, the attention has been directed to the analysis of surgeon's reliability/unreliability in robotic surgery, as the new frontier of mini-invasive surgery, which has the potential to improve surgical outcomes in terms of optimizing precision and speeding up recovery. At the best of authors' knowledge, this is the first application of HRA in robotic surgery.

Beyond the scope of fostering the HRA applications in surgery, there is also hope that the taxonomy will be useful for surgeons, organizations and technology providers, for spreading better awareness about the nature and role of influencing factors on surgeons' performance. In this direction, the taxonomy might be applied in future, for example, to support the training or the ergonomic design of medical devices, and surgical safety checklists. The ultimate goal of this research is to contribute to the long-lasting improvement of surgical outcome and patient safety; the second one is to promote a human–centred continuous improvement of healthcare practices, aimed at quality of care and patient safety, in a context of rapid technological an organizational innovation.

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ERGONOMIC ANALYSIS OF TASKS IN THE MEAT PROCESSING INDUSTRY : A CASE STUDY.

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Abstract

Current trends indicate the incidence of musculoskeletal disorders may rise with employment levels, many instances involving harm, psychosocial factors, absence and cost. Consequently a meat processing plant agreed to participate in this study. The study involved a number of ergonomic assessment methods, including Repetitive Multi Task NIOSH, ART, RULA, REBA and MAC, some used in parallel, which provided valuable data. In turn this paper aims to illustrate how ergonomic analysis and related data expedited a participatory approach to an ergonomic strategy within a meat processing environment.

Introduction

Factors giving rise to Musculoskeletal Disorders (MSD), within the meat processing sector are well documented (HSA, 2015, HSE, 2002, 2015, BMPA 2014). Savescu (2018) lists common risk factors to the sector, including repetition, force, static postures, low temperature, work organisation and lack of recovery time. Barbut (2014), when looking at automation within the sector refers to variances in materials being processed, human adaptability and how the meat sector may have lagged behind when it comes to automation.

Context

The Health and Safety Authority and Economic and Social Research Institute (HSA, ERSI, 2018) reported that the incidence of MSD in Ireland rose and fell with employment rates in the period 2002 to 2013. The MSD rate per 1000 workers went from 11 in 2002, to 7 in 2009 rising again to 16 per 1000 workers in 2013. 50% of those who reported MSD did not endure work absence noting the average absence during that period was 16 days. The same report refers to studies which estimate the cost of MSD in the UK to be £10 billion (~ €11.2 billion) per annum.

This study involved a meat processing plant, employing approximately 1000 employees processing a range of ham products. The plant comprises of 10 production departments supported directly by warehouse, facilities and engineering functions. The plant maintains an occupational health and safety management system (OHSMS), key controls are integrated into business processes and incorporates principles relating to accountability and absence management. The plant maintains an occupational health department which works closely with external physiotherapists and an occupational health physician.

Production employees receive manual handling training at induction which includes ergonomics and, which is repeated periodically. Initial job specific training is conducted over a 6 week period, the pace of work for both new and returning employees is gradually built up, using tools derived from RULA (McAtamney, Corlett, 1993) and MAC (HSE, 2014), employees are assessed and receive specific posture coaching periodically or more frequent, as necessary. The level of job rotation varies across production departments, all departments will accommodate modified duties when instances where MSD has occurred.

A preliminary review of plant procedures and processes was conducted, this involved human resources, occupational health, safety, production and engineering functions, perception indicated failures were possible, this formed the basis of discussion. A review of 100 MSD reports which occurred over a 5 year period was then conducted, 19 of these reports were immediately discounted due to significant multifactorial psychosocial etiology, of the 81 reports remaining, department, age, gender, length of service and nature of MSD was noted. Based on population, incidence and severity this exercise determined a meat slicing operation should be the focus of the case study. A slicing line consists of slicing, pick and place, boxing and palletizing workstations.

Slicing Role

Workers are male and do not rotate, the weights handled are 7 to 14kg consisting of formed deli ham logs, depending on product type, these are delivered to the workstation on 2 different types of racks, highest rack selves are at 175cm or 178cm, lowest shelves are at 30cm or 27cm. Racks are placed at an angle to the slicing machine, workers take the logs using one and then two hands, turning and placing it on a machine loading table located at 90cm. Some logs are cooked within a casing which is removed using a small knife. Workers report weight and shelf height are significant effecting their neck, lower back and right shoulder.

Pick and Place

Workers are predominantly female and rotate every 2 hours across left and right workstations, the right workstation involves more variety with machine control and checking duties benefiting the workers left side, high speed repetitive work, the weights handled are 150g to 500g consisting of sliced ham bundles which are delivered by a conveyor. Individual variability is evident, workers take the bundles using a pinch grip placing them into blister packs, product may be passed from one hand to the other before being placed. The workstations range between 92cm and 97cm in height, the reach distance between 15cm to circa 45cm. Workers report pace is significant and work may effect the neck, shoulder, arm, wrist and hands.

Table 1. Preliminary review of plant specific processes

Functions	Process
Human Resources & Occupational Health	Pre-employment selection
	Pre-employment medical
	Correct placement of new employees
	Periodic health screening
	Early reporting procedures
	Supervision of rehabilitation and modified duties
Human Resources & Production	Adequate manual handling and ergonomic training at induction
	Adequacy of job specific training
	Work posture assessment and coaching
	Refresher training
	Training acknowledgements and preservation of records
Production & Safety	Adequate risk assessment
	Adequate safe systems
	Proof work has been considered and planned safe
	Proof of supervision
	Proof error and poor custom and practice is identified and addressed
	Proof changes have been considered and planned safe
	Work areas are organised, controlled and tidy
	Workers control pace
	There are adequate rest and recovery periods
	Rotation occurs, is logical and not detrimental
	Rotation records are preserved
Engineering & Safety	Tools and machinery comply with appropriate EN standards
	Machinery is CE marked
	Workstation design demonstrates sound ergonomic principles
	Materials and tools are designed easy to handle
	Vibration, lighting, noise, and temperature is controlled

Table 2. MSD incidence per department

Department descriptive	Difficulties	Approximate distribution of workers	MSD incidence per 1000 workers
7-14Kg Bulk product	Back pain	80	35
7-14Kg Slicing	Back pain / shoulder / arm / wrist / hand	180	32
7-14Kg Forming	Back pain	60	27
Curing	Back pain	45	18
5Kg Slicing	Back pain / shoulder / arm / wrist / hand	80	18
Meat cutting	Back pain / shoulder / arm / wrist / hand	130	15
High speed filling and packing	Back pain / shoulder / arm / wrist / hand	120	10
Facilities and cleaning	Back pain	60	7
Mixed production processes	Back pain	60	3
Mixing and filling small product	Back pain	30	0
Warehouse activities	Back pain	40	0
Maintenance	Back pain	35	0
Administrative	Neck / shoulder / wrist / hand	80	0
2013 National rate			16
Total		1000	

Boxing

Workers are predominantly female and rotate every 2 hours across left and right workstations, then to palletizing, repetitive work, the weights handled are 150g to 2.5Kg consisting of sliced ham packs and finished cartons. Individual variability is possible. Packs are delivered via a conveyor onto a packing table, workers assemble flatpack cartons, using a pinch grip, gather and check packs before placing them into the carton, closing it using a tape gun, labelling it and pushing the finished carton to the end of the table. The workstations range between 76cm and 88cm, the reach distance is up to 70cm. Workers report pace is significant and work may effect the neck, shoulders and back.

Palletizing

Workers are predominantly female and rotate every 2 hours across onto packing tables, the weights handled are 2.5Kg to 27Kg consisting of finished cartons and wooden pallets. Individual variability is possible. Cartons are taped closed and labelled as necessary, lifted from the end of the packing table (76cm to 88cm in height), workers then turn and stack them on the pallet, completed pallets are then loosely wrapped before being removed by other workers. Pallets are placed at ground level, between 60cm to 150cm from the packing table, completed pallets are approximately 120cm in height, the highest stack of stock pallets are approximately 150cm. Workers may stack for 2 production lines, and work may effect their lower back.

Methods

The Revised NIOSH Repetitive Multi Task Method (Waters, Putz-Anderson & Garg, 1994), REBA (Hignett, McAtamney, 2000), RULA (McAtamney & Corlett, 2000), ART (HSE, 2010), and MAC (HSE, 2014) were used to assess aspects of the workstations described. These were selected noting applicability, familiarity and ease of use, none requiring special tools to be used.

Participatory Approach

Of the workers assessed most reported some difficulty which they associated with their duties, due to confidentiality and reliability of data, individual medical histories were not reviewed. Rotation and other organisational issues were evident (Hagg, G.M, 2003), as were psychosocial factors (Choobineh et. al., 2011, Robertson et al., 2008), for these reasons a participatory ergonomics approach was chosen and a multifunctional team consisting of workers, management, engineering, safety and occupational health formed. Hagg (2003), spoke of how external consultants may be used to expediate programmes and with resources and a mandate secured (Tappin et al., 2016), subsequent to the initial review of MSD incidence, an external consultant launched the programme presenting some ART assessments and related training, from which this study grew and detail was added to the intervention programme.

Table 3. Application of ergonomic assessment tools

Work station	Sample size	Method	Objective	Ratings
Slicing	15	NIOSH RMT	Assess weights & rack shelf heights over 8 hours	<1 low risk, 1-2 medium risk, >2 high risk
			Generate data to aid rotation	
		REBA	Screen whole body postures as logs are handled	1 Negligible risk, 2-3 low risk, 4-7 medium risk, 8-10 high risk, 11+ very high risk
			Use body sector data to identify individual variability	
		MAC	Assess the lifting task	Green low risk, amber medium risk, red high risk, purple very high risk
			Workers are familiar & can participate	
Pick & Place	18	ART	Screen pick & place task involving the upper limbs and body	0-11 Low risk, 12-21 medium risk, 22+ high risk
			Consider coupling, duration, recovery and psychosocial factors	
		RULA	Assess pick and place task involving the upper limbs and body	1-2 Negligible risk, 3-4 low risk, 5-6 medium risk, >6 very high risk
			Workers are familiar & can participate	
Packing	18	ART	Assess packing task involving the upper limbs and body	As above
			Generate similar data to pick & place to aid rotation	
			Use body sector data to identify individual variability	
		RULA	Assess packing task involving the upper limbs and body	As above
			Workers are familiar & can participate	
Pallet	7	ART	Assess taping and labelling cartons involving the upper limbs, noting other body sectors	As above
			Consider coupling, duration, recovery and psychosocial factors	
		REBA	Screen whole body postures as cartons are handled	As above
			Generate body sector coding data	
Total	40			

Table 4. Slicing assessment scores

Worker	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15
Height cm	180	173	168	178	185	178	185	170	190	190	170	180	190	168	180
Age y	30-40	30-40	30-40	30-40	20-30	50-60	40-50	30-40	40-50	40-50	30-40	40-50	50-60	30-40	30-40
Gender	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Line	19	17	17	16	16	13	12	12	11	11	10	10	9	9	21
Repetitive Multi Task NIOSH															
Load	13	12	14	9	12	7	6	7	12.5	13	13	12	10	8	14
Max STRWL	13.06	13.06	13.06	13.06	13.06	13.06	13.06	13.06	13.06	12.1	12.1	13.06	13.06	13.06	13.06
Min STRWL	7.93	7.93	7.93	7.93	7.93	7.93	7.93	7.93	7.93	8.1	8.1	7.93	7.98	7.98	7.98
Max STLI	1.63	1.5	1.67	1.13	1.5	0.88	0.75	0.88	1.57	1.54	1.54	1.5	1.25	1	1.67
Min STLI	1	0.92	1.02	0.69	0.92	0.54	0.46	0.54	0.96	0.96	0.96	0.92	0.77	0.61	1.02
Compound lifting index	1.69	1.67	1.86	1.25	1.67	0.97	0.83	0.97	1.74	1.69	1.69	1.67	1.2	1.11	1.86
REBA Scores															
Neck position	3	3	3	2	3	1	3	2	3	3	1	3	2	1	2
Trunk position	4	3	4	2	4	3	3	3	4	4	2	3	4	3	2
Legs	2	2	2	1	2	2	2	2	2	2	1	2	3	1	2
Posture score	7	6	7	3	7	4	6	5	7	7	2	6	7	2	4
Force / load	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Upper arm position	4	4	5	3	4	3	4	4	5	5	5	4	3	3	5
Lower arm position	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wrist position	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
Coupling score	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Activity score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
REBA score	12	11	13	9	12	9	11	10	13	13	10	11	12	8	11
Manual handling assessment charts															
Lifting frequency	G0														
Horizontal distance	G0														
Vertical lift region	R3														
Twist & or bend	R2														
Posture	G0														
Grip	R2														
Environmental	G0														
Floor	G0														

Table 5. Pick and place assessment scores

Worker	M1		M2		M3		M4		M5		M6		M7		M8		M9		M10		M11		M12		M13		M14		M15		M16		M17		M18	
Height cm	168		168		163		165		163		165		163		165		158		165		163		172		165		163		172		169		169		164	
Age y	30-40		30-40		40-50		20-30		40-50		30-40		20-30		40-50		30-40		30-40		30-40		30-40		50-60		40-50		30-40		30-40		30-40		30-40	
Gender	F		F		F		F		F		F		F		F		F		F		F		F		F		F		F		F		F		F	
Line	L19		L19		L17		L17		L16		L16		L16		L9		L9		L11		L11		L13		L13		L12		L12		L21		L21		L21	
Workstation position	Left		Right		Left		Right		Left		Right		Right		Left		Right		Left		Right		Left		Right		Left		Right		Service		Seated		Left	
Left / Right side	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R
ART Scores																																				
Arm movement	5	4	4	5	5	4	4	5	5	4	4	5	4	5	6	4	4	5	5	4	4	5	5	4	4	5	4	5	5	4	3	3	3	3	4	6
Repitition	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	3	3	2	3	4	6
Force	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Head / Neck posture	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Back posture	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1
Arm posture	4	3	3	4	4	2	3	4	4	3	3	4	3	4	4	3	3	4	4	3	3	4	4	3	3	4	4	3	3	4	2	2	1	2	3	4
Wrist posture	1	2	2	1	2	1	1	2	2	1	1	2	1	2	2	1	1	2	2	1	1	2	2	1	1	2	2	1	1	2	1	1	1	1	1	1
Hand / Finger grip	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	2
Breaks	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Work pace	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	2	2	2	2
Other factors	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Task score	28	27	26	27	28	24	25	28	28	25	25	28	25	28	29	25	25	28	28	25	25	28	28	25	25	28	27	26	26	27	17	17	18	20	22	28
Duration	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ART exposure score	**28**	**27**	**26**	**27**	**28**	**24**	**25**	**28**	**28**	**25**	**25**	**28**	**25**	**28**	**29**	**25**	**25**	**28**	**28**	**25**	**25**	**28**	**28**	**25**	**25**	**28**	**27**	**26**	**26**	**27**	**17**	**17**	**18**	**20**	**22**	**28**
RULA Scores																																				
Upper arm position	3	2	2	3	3	2	2	3	3	2	2	3	2	3	3	2	2	3	3	2	2	3	3	2	2	3	3	2	2	3	2	2	2	2	2	2
Lower arm position	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	1	1	1	1	3
Wrist position	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	2	2	2	3	3
Wrist twist	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Table A posture score	5	4	4	5	5	4	4	5	5	4	4	5	4	5	5	4	4	5	5	4	4	5	5	4	4	5	5	4	4	5	3	3	3	3	3	4
Muscle score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Force / Load score	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Table C score	6	5	5	6	6	5	5	6	6	5	5	6	5	6	6	5	5	6	6	5	5	6	6	5	5	6	6	5	5	6	4	4	4	4	4	5
Neck position	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	2	2	2	2	3	3	2	2	2	2	2	2
Trunk position	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3
Legs	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Table b score	3	3	3	3	2	2	2	2	2	2	2	2	2	2	3	3	2	2	2	2	2	2	3	3	2	2	2	2	3	3	2	2	2	2	4	4
Muscsle score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Force load score	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Table C score	4	4	4	4	3	3	3	3	3	3	3	3	3	3	4	4	3	3	3	3	3	3	4	4	3	3	3	3	4	4	3	3	3	3	5	5
RULA score	**6**	**5**	**4**	**4**	**5**	**4**	**4**	**5**	**5**	**4**	**4**	**5**	**4**	**5**	**6**	**5**	**4**	**5**	**5**	**4**	**4**	**5**	**6**	**5**	**4**	**5**	**5**	**4**	**5**	**6**	**3**	**3**	**3**	**3**	**5**	**5**

Table 6. Packing assessment scores

Worker	P3		P4		P5		P6		P7		P8		P9		P10		P12		P11		P13		P14		P15		P16		P17		P18		P1		P2	
Height cm	153		155		175		168		155		158		155		160		175		168		160		155		165		170		175		167		183		180	
Age y	40-50		50-60		40-50		30-40		30-40		30-40		50-60		40-50		50-60		30-40		30-40		50-60		40-50		50-60		40-50		60-70		50-60		30-40	
Line	L19		L19		L17		L17		L17		L16		L16		L13		L12		L12		L11		L10		L10		L10		L9		L9		L21		L21	
Workstation position	Left		Right		Left		Right		Left		Right		Left		Right		Left		Right		Left		Right		Left		Right		Right		Left		Seated		Seated	
Left / Right side	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R
ART Scores																																				
Arm movement	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Repitition	2	2	2	3	2	3	2	3	2	3	2	3	1	3	1	3	1	3	1	3	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3
Force	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Head / Neck posture	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	0	0	1	1	1	1
Back posture	1	1	1	1	1	1	0	0	0	0	0	0	1	1	0	0	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1
Arm posture	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	2	2	2	2	2	2	2	1	2	1	2	1	2	1	2	1	2	2	2	1	1
Wrist posture	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Hand / Finger grip	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Breaks	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Work pace	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	1
Other factors	1	1	1	1	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	0	0	0	0	0	1	1	1	0	0	0	0
Task score	17	17	17	18	16	17	16	17	16	17	15	16	13	16	14	17	15	17	15	17	13	13	13	14	12	13	13	14	13	15	13	14	17	17	16	16
Duration	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ART Exposure score	17	17	17	18	16	17	16	17	16	17	15	16	13	16	14	17	15	17	15	17	13	13	13	14	12	13	13	14	13	15	13	14	17	17	16	16
RULA Scores																																				
Upper arm position	1	1	1	1	1	1	1	1	2	2	2	2	1	1	2	2	2	2	1	1	2	2	2	2	2	2	2	2	2	3	3	3	1	1	1	1
Lower arm position	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wrist position	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	2	2	2	2
Wrist twist	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Table A posture score	2	2	2	2	2	2	2	2	3	3	3	3	2	2	3	3	1	3	2	2	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2
Muscle score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Force / Load score	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Table C score	3	3	3	3	3	3	3	3	4	4	4	4	3	3	4	4	4	4	3	3	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3
Neck position	3	3	2	2	3	3	2	2	2	2	2	2	1	1	2	2	2	1	2	2	1	1	2	2	2	2	3	3	2	2	2	2	3	3	3	3
Trunk position	1	1	2	2	2	2	2	2	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	2	2
Legs	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Table b score	3	3	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	2	2	2	2	4	4	3	3
Muscsle score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Force load score	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Table C score	4	4	3	3	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	3	3	3	3	5	5	4	4
RULA score	4	4	3	3	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	3	3	3	3	4	4	4	4

Table 7. Label & Palletizing assessment scores

Worker	PT1		PT2		PT3		PT4		PT5		PT6		PT7	
Height cm	186		160		160		180		168		165		180	
Age y	30-40		50-60		30-40		50-60		50-60		30-40		30-40	
Gender	M		F		F		F		M		F		M	
Line	L21		L19		L13		L13		L12		L11		L10	
Workstation position	**Pallet**		**Pallet**		Left		**Pallet**		**Pallet**		**Pallet**		**Pallet**	
Left / Right side	L	R	L	R	L	R	L	R	L	R	L	R	L	R
ART Scores														
Arm movement	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Repitition	2	2	2	2	1	3	1	3	1	3	1	1	1	1
Force	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Head / Neck posture	1	1	1	1	1	1	2	2	1	1	1	1	1	1
Back posture	1	1	2	2	1	1	1	1	1	1	1	1	1	1
Arm posture	2	2	1	1	1	2	1	2	2	2	2	2	0	0
Wrist posture	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Hand / Finger grip	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Breaks	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Work pace	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Other factors	1	1	0	0	0	0	1	1	1	1	0	0	0	0
Task score	17	17	16	16	14	17	15	18	14	16	13	13	11	11
Duration	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ART Exposure score	17	17	16	16	14	17	15	18	14	16	13	13	11	11
REBA Scores														
Neck position	2		2		2		2		2		2		2	
Trunk position	4		4		4		4		4		4		3	
Legs	2		2		2		2		2		2		2	
Force / load	0		0		0		0		0		0		0	
Upper arm position	2		2		2		2		2		2		2	
Lower arm position	2		2		2		2		2		2		2	
Wrist position	1		1		1		1		1		1		1	
Coupling score	1		1		1		1		1		1		1	
Activity score	1		1		1		1		1		1		1	
REBA score	7		7		7		7		7		7		7	

Observations and Discussion

The Repetitive Multi Task NIOSH equation illustrated the relative risk associated with the various shelf heights contained within the racks, the highest 2 and lowest posing most risk. By calculating the Compound Lifting Index a simple means of developing logical rotation was gained.

The placement of the rack relative to the slicing machine's loading table is not standardised, workers were observed placing the rack as close to the loading table as possible at angles of 30^0 to 80^0 relative to the loading table encouraging some workers to bend and twist as they handled the deli ham logs. This, combined with the Hawthorn effect may have influenced REBA scores, which ranged from 9 to 13. As expected most individual variability was seen in neck and trunk positions. MAC (HSE, 2014) assessments conducted with workers suggested bending and twisting was feasible on all lines.

On review of the Pick and Place assessments, L21 was assessed separately as machinery configuration was slightly different, on the other lines which were comparable REBA and RULA scores were 25 to 29 high risk, and 4 to 6 moderate to high risk. When using two assessment methods in parallel differences were expected Chiasson, Imbeau, Aubrey, Delisle, 2012), noting RULA was not as conservative as expected (Chiasson et al., 2012, Hunter, 2002). Differences in the loading between left and right sided workstations was seen but almost negligible and rotating across these two workstations every two hours is insufficient. Data highlighted how the height of the conveyor delivering product to the workstation provoked workers to raise shoulders and abduct arms.

Neck and truck postures were influenced by worker height relative to the workstation, RULA generated higher scores for neck and truck position than ART, as position only and not duration was scored. This stooping highlighted opportunities to improve workstation design, training, and supervision (Deros, Darvis, Basir, 2015).

ART and RULA scores for the Packing task ranged from 13 to 18 moderate risk and, 3 to 4 low risk, respectively. Again RULA generated higher scores for the neck and trunk position, noting workers in this area also spoke of discomfort associated neck, shoulders and upper back, similarly this resulted in an anthropometric design review.

The assessment scores are significantly lower than those for the Pick and Place workstation clearly indicating an opportunity to load share and rotate workers through Pick and Place, Packing and Palletizing tasks. This hasn't happened before as production lines cut through a physical wall which protects the cooked unpackaged product during slicing and placement, noting hygiene protocols the journey time for workers is approximately 15 minutes. It should also be noted that workers involved in the packing and palletizing tasks are slightly older and have expressed a reluctance to rotate.

This assessment programme has provided a confluence of circumstance. Training, competency, and assessment data has provided confidence and direction, facilitating sound, bottom up and top down communication involving workers and management. At the time of writing workers had already started cross training and the process of introducing rotation across these three workstations. The initial review of MSD incidence per department providing reluctant workers, in time to redeploy.

The ART assessment scores for the Palletizing task were similar to those for Packing, taping and labelling duties being shared as necessary. The REBA results were identical due to a higher level of work standardisation, pallet, location of the pallet and table heights. Noting workers tendency to stoop may be reduced through training, supervision and mechanical lifts.

Conclusions

The review of MSD incidence within the plant illustrated areas where resources were required and lower risk areas where workers may be accommodated. Competency and assessment data has facilitated an effective participatory ergonomics approach. When using more than one assessment method in parallel proved useful when assessing body sectors, posture, individual variability and risk.

The use of the Repetitive Multi Task NIOSH method has made a rotational sequence on Slicing workstations obvious. By standardizing the placement of the rack inline with slicing machines (not at an agle), worker's tendency to bend and twist will be reduced. The risk associated with rack shelf heights may be reduced using mechanical lifts or simple steps.

The height of delivery conveyors, feeding product to the Pick and Place workstation can be easily reduced in height reducing the need to abduct the arm. Rotation every 2 hours from left to right Pick and Place workstations has minimal impact and should be reduced further, cross training and rotating with Packing and Palletizing workers has to progress to share the load. The specification for new production lines can be changed ensuring the Pick and Place task is automated. Similarly Packing and Palletizing tasks will benefit from anthropometric design review and the introduction of collators, rotating tables, boxing and palletizing machinery will inevitably reduce or remove associated MSD risk.

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Can the seated posture of school children be improved by a change in seat pan slope?

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Abstract

Several previous studies have identified postural benefits of chairs with a forward-sloping seat pan. An educational survey was conducted to explore the impact on a child's posture while sitting on a 5^{o} forward sloping wedge cushion (wedge). Nineteen children were surveyed with full permission from their guardians. The children were given a 15-minute verbal instruction-demonstration in how to use the wedge. Differences were observed over two time periods (once in November 2015 and once in June 2016). The 'control group' consisted of 19 age-matched students in the other 4th class who were given neither wedges nor instruction. Data collection included (1) photographs taken by the class teacher of pupils using the wedge and those in the control group (no wedge), (2) objective assessments made by Alexander Technique trainees of postures as found on arrival (November) and eight months following (June) (3) subjective comments from children after eight months of consistent use in the classroom, and (4) a narrative report written by the class teacher. Improvements in posture were noted in all areas of data collection. The impact of a forward sloping seat on seated postures of school children merits further research, particularly in view of the current European Standards Committee for School Furniture which now permits this adaptation in chair design.

Introduction

A healthy posture in the majority of pre-school children is characterised by a supported upright and freely moving spine. Yet, in industrialized civilisations, the majority of teenagers and young adults develop poor posture. Poor posture is often characterised by a slouched appearance, rounded shoulders, an overly-curved back and a forward head. Poor posture not only can cause back and neck pain, but it also can cause numerous other musculoskeletal problems. It also can affect the way a child breathes. Slumped posture constricts the ribcage, leaving less space for the lungs to take in air. Less available oxygen in the body means the child's overall health and learning abilities can be compromised. It would be important, therefore, to identify -- and redress --the main factors contributing to the deterioration of children's posture as they progress through the school years into adolescence. Much discussion has taken place in recent years about whether children at school spend too much time sitting. One solution to this has been to introduce more physical exercise to cope with this problem. Unexamined, however, has been the type of chair children are sitting on. Could chair design also be a major factor in posture deterioration during the school years? This survey was designed to address this question. The purpose of this educational effort was to survey objective and subjective responses to adapted seating from a sample of primary school children over an eight-month period. The adaptation was to place a wedge-shaped cushion on each child's usual classroom chair.

The survey was conducted with full approval of the school principal and the student gaurdians gave written permission for the childern to be involved in the study.

The specifications for primary school chairs have recently been altered by the European Standards Committee for School Furniture (Document Ref: EN 1729-2+AT2015, 2012). At the present time, all schools in Europe are free to use chairs with a seat that can slope between 5 degrees backward (-5^{o}) to 8 degrees (8^{o}) forward. This is a major advancement in furniture standards and their potential effects on posture. Do these backward-sloping seats actually support the child in maintaining a healthy posture during their year in school? According to Candy EA. *et al.* (2005), a backward sloping seat does not promote good posture while sitting. Backward sloping seats cause a child's pelvis to be 'pulled' backward as he or she must lean forward to write at their desk. This results in an overly rounded spinal curvature that children must sustain for the majority of the sitting period. Other studies like Mandal, A.C. (1981)', National Back Pain Association (2005) and Mc Dougall (2012) identify the benefits of a forward sloping seat.

Method

Nineteen fourth-class pupils (averaging 10 years old) from the Claddagh Primary School, Galway City, Ireland, were asked to participate. Each child was provided with a wedge-shaped cushion which was routinely used between November 2015 and June 2016. The wedge cushion was made of 8lb chip foam, rendering it firm upon sitting. The cushion was angled at 8 degrees (8^{o}) and its dimensions were 35.5cm x 35.5cm. As the school chair seat was sloping backwards by three degrees (-3$^{o)}$ to begin with, the children were actually sitting on a forward slope of 5^{o}. Figures 1 and 2 show the impact of placing the wedge-shaped cushion on the seat

None of the children had had prior experience with a wedge shaped cushion. The teacher also was not familiar with the wedge cushions. 19 age-matched children in the other 4th level class were not given wedges. Nor were these children aware of the conditions of the survey or the use of the wedges.

On the day the cushions arrived in the classroom (4th November 2015), the children were given a 15-minute verbal presentation and demonstration by Richard Brennan, Director of the Alexander Technique Centre Galway, Ireland. The presentation included:

1. A simple (age-appropriate) anatomy lesson of the pelvic base (sitting bones) and spine;
2. A visual description of how children's posture can be negatively altered from the ages of toddler to teenager; and
3. The role played by school chairs in contributing to the negative changes in posture.

Mr. Brennan brought in a model spine to show the children how their sitting posture is affected by balancing on their sitting-bones. The children were also shown how they could rock forward on the sitting bones when leaning forward, thus keeping their spine supported and erect while working at their desks.

The children were then taken in groups of five pupils (four groups in all). Four trainees on the Alexander Technique Teacher Training course were assigned to assist in the experiential learning segment, one trainee per group. Two qualified Alexander Teachers (STAT) were present who oversaw and advised the trainees. They were each given a wedge and shown how to correctly position it on the chair. The trainees showed the children how to find their hip joints and their sitting-bones, and how to balance on the sitting bones to help the spine stay upright when working at the desk. They were also shown how placing their feet flat on the floor can promote good posture.

Observation of the children's postures were recorded by the trainees before the intervention (4th November 2015) using a 'Yes or No' response form (Appendix 1). A second recording of observations also took place on 14th June 2016. The children were observed for the presence of conditions including the following:

1. The back remains straight and bending is at the hip joints.
2. Both feet remain flat on the ground.

By permission, the class teacher took photographs of the 4th class students over the period of the study. The teacher also photographed the second 4th class, those not provided with wedges nor informed about the survey. Finally, the class teacher wrote up a short report of the experience of using the cushions in the classroom.

Results

Observational survey of children's posture before and after the intervention

In Table 1, the major finding of the survey is the objective improvement in posture between November 2015 and June 2016 in the majority of pupils according to three assessment conditions. Using the wedge cushions, the majority of pupils were sitting (apparently spontaneously and comfortably) with their backs straight and were moving from their sitting bones to tilt forward. Improvement was also observed between the two time periods in the increased number of pupils who placed their feet flat on the floor. Given the lower numbers of students with foot placement both pre- and post-conditions, however, further research is warranted on this phenomenon.

Table 1. Observed postural results Prior to and Post intervention

Observed Postures	**Prior**			**Post**	
	Yes	No		Yes	No
1. The back is straight and the hip joints are bending	3	16		14	5
2. Both feet are flat on the ground	2	17		5	14

Figure 1: Chair with backward sloping seat

Figure 2. Chair with wedge cushion

Survey of children's views on the cushions and their posture, as recorded by the children.

At the end of the survey on 14th June 2016 children were asked to complete a form and trainees observed their postures as they completed this task. See Appendix 2 for the form used.
The three questions asked were:

1. What do you think of the cushion?

2. Do you think the cushion has changed how you sit? If it has list all the ways.
3. What would you be most likely to say about the cushions?

The following answers were given by the children:

What do you think of the cushion?

- I think the cushions are comfortable and helpful
- It's great and it's comfortable.
- It helps with my back and sitting straight
- It's good.
- I think the cushions are great for your spine and they are very comfortable and helpful.
- It's comfortable and its way better than the chair.
- The cushions helped me sit up straight and help my back and help me reach the table and I think they should give more schools these to help more people sit up straight.
- It's cool like fluffy and comfortable and is like a pillow.
- I think it is comfortable, nice and good. It helped me really good to sit properly and don't injure my back.
- I think the cushion was helpful
- Is very good for your back; Is fun; is playful
- I think it is very helpful and I feel very straight
- I think the cushion is great for your back; I think it is comfortable; I think it helps you not to slant; I think it makes you sit up straight
- It is nice comfortable, relaxing and great
- It is good and comfortable
- I like it. It is very comfortable and it definitely changed the way I sit.
- I think that the cushion is wonderful.
- I think that you can sit very good.
- I think the cushion in good because it helps people reach the table and is very comfortable

Do you think the cushion has changed how you sit? If it has list all the ways.

- Sit straight; not slouching; making it comfortable
- I sit more straighter
- The cushion helped my posture; It is more comfortable
- I don't think it helped me, but if I get to keep it will help.
- It helps me sit properly; it is comfortable; it is made from foam and is helpful.
- It has changed my back is not sore.
- It made me more comfortable; it made me stop going on my knees to sit down.
- If I did not have the cushion my back would be sore and with this cushion it feels good.
- It makes me sit better; It is comfortable; It helped my back
- Is comfortable; Is fun and useful; Is second best colour; Is super and hard
- It makes me straighter; It feels good; I feel straighter

- I've not been slouching; I've not been uncomfortable; I sit up straight without even knowing
- Good posture
- I feel taller when I sit; I like that you can remove it from the chair if you are not comfortable
- I don't sit on my knees any more; I not naturally sit up straight on every chair. I'm much more comfortable sitting now when I write; I don't put my head on the table.
- I think they are very comfortable
- I can reach the table easier

What would you be most likely to say about the cushions?

- They are the best!!!!!!
- They're great!!
- I like them.
- They are awesome nearly like me.
- It helps me sit properly;
- They are very comfortable and soft.
- Sell more of these to more schools to help those children as well
- That it is comfortable and awesome cool and it helps straightening my back so I love it.
- Keeps me straight; It makes me feel comfortable; It doesn't injure my back
- I never want to get off
- They are very stable and very comfortable and very light
- They are very good for your back
- They are so helpful
- The cushion feels comfortable and gives me good posture
- It is comfortable
- They're comfortable and very good if you sit in awkward ways. If these were for sale I would buy one.
- It is the best
- The cushion is very good
- They are good for our posture so we can do our work easier

Photographic evidence of children's seated postures

The class teacher photographed the class on two occasions during the period of the survey. He also photographed the 'control group,' the second 4th year class members who had not been given wedges.

In the photographs, the children have better posture when sitting on the wedges, that is, sitting comfortably upright with less collapse of the spine. The pictures show a variety of positions on the seat pan. It is worth noting that perching on the front edge of a backward sloping seat can be a way of eliminating the negative impact of the seat on posture. The children were not aware that they were being photographed although both the parents and the children had previously given their permission.

Teacher's report on use of wedges

Below is the teacher's report on the results of the experiment, restated verbatim (with permission).

Teacher's report

Wedge Cushion Survey – Claddagh N.S., Galway, 2015-2016

Personal Observations of Class Teacher, Seán Leonard

23rd June 2016

The children of my class were very excited about the prospect of getting their wedge cushions at the outset of this project, and were unanimously positive about them upon receiving them.

Having taught for a number of years, I assumed that this was childish excitement at the novelty of getting something new and different. Strikingly, and surprisingly, rather than diminishing with familiarity, the children's attachment to, and appreciation of, the cushions appeared only to grow as the year continued. The teacher reported that no instances in which a child voluntarily removed the cushion, that is, choosing to prefer sit on the bare chair seat. If a cushion had been misplaced from a child's chair, he or she would insist upon locating it before sitting down.

At the end of the study period, the universal concern among the children was that their cushions were going to be taken away.

Initially, I noticed a significant improvement in the children's seated posture, but this awareness dulled as the months wore on and I became familiar with them sitting on them every day. Indeed, perhaps typically for a teacher, I was prone to noticing only when they were *not* sitting well. It was when colleagues from other classes came into my room during the year, and noticed the remarkable difference between the posture of the children in their rooms, and the children using cushions in mine, that I realised the cushions were obviously still effective.

Personally, I see this as a worthy and progressive experiment, and one that has, at the very least, provided the children with a heightened awareness of the importance of good seated posture.

Discussion

The primary purpose of this educational survey was to observe the changes in postural behaviour of a group of primary school children in response to the use of wedge shaped cushions. The team of educators and observers included the Alexander Technique Teacher Training Director, an Alexander Technique teacher, four Alexander Technique Teacher trainees, and the classroom teacher. Objective improvements in the sitting posture of the majority of children over time were observed. Subjective results collected showed a robustly positive response to the cushion adaptation. The children responded positively to using the cushion when surveyed in June 2016. Not only was the childrens improved upright posture objectively observed while working at their desks, but they also self-selected the wedge cushion without encouragement or coercion.

Results from photos were mixed. Not all children using the wedge cushion demonstrated observable improvement according to the criteria selected by the educational team. However the photographs clearly demonstrate an improvement in comparison to the photos of the 'control group'. The children's subjective responses, suggest that the cushion gave improved support and ease of sustained sitting. The teacher also responded positively to what he saw as lasting behavioural changes in the children. Finally (though not officially surveyed) other staff members remarked that they observed a difference in the children using the cushions.

To date, almost all school chairs have been designed with a backward-sloping seat. Campaigns advocating a change in chair specifications, have been successful at the EU level. In the European

Standards Document Ref: EN 1729-2+AT2015, 2012 specifications for seat angles now permit a forward-sloping seat pan. The results of this survey advocate for more awareness around chair design, to promote healthy posture. We recommend further research in this area.

In conclusion, simple changes can make a beneficial impact on improving postural behaviour. Future research might confirm our survey findings and expand to investigate the impact of these postural changes on school performance. Such research potentially will have a vital impact on our children's future.

Research Recommendations

As a result of this survey, the authors suggest the following recommendations for future research:

1. Research to check the preliminary result and premise of this educational survey
2. A longitudinal study where five-year-old children are provided with a forward sloping seat pan until finishing primary school
3. A cross-comparative study of larger sample sizes in several schools
4. A study on the effects of a forward sloping seat pan with secondary school children.
5. Research into the effects of a sloping writing block on seated posture.

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Appendix 1

Educational Survey
Impact on pupils' posture of use of wedges on school chairs
4th Class, St Nicholas's Primary School, Claddagh.

<table>
<tr><td>Child's Name:</td><td>Date of Birth:</td><td colspan="2">Height(circle):
below class avg
class avg
above avg</td></tr>
<tr><td colspan="4">As the child completes a written exercise seated (without a wedge) at a desk, complete the following observations with regard to the child's posture.
(If the child moves during the period of observation record the posture most frequently held).</td></tr>
<tr><td colspan="2">Initial Observations</td><td>yes</td><td>No</td></tr>
<tr><td colspan="2">The back is straight and bending is at hip joints (if no continue below at 2.1)</td><td></td><td></td></tr>
<tr><td colspan="2">Both feet are flat on the ground (if no continue at 3.1 below)</td><td></td><td></td></tr>
<tr><td colspan="2">The pen is being gripped tightly</td><td></td><td></td></tr>
<tr><td colspan="2">The head is positioned to one side</td><td></td><td></td></tr>
<tr><td colspan="2">Additional Observations</td><td></td><td></td></tr>
<tr><td colspan="2">2.1 The child is bending at the back and collapsing spine</td><td></td><td></td></tr>
<tr><td colspan="2">2.2 One shoulder is higher than the other</td><td></td><td></td></tr>
<tr><td colspan="2">2.3 The body is twisted</td><td></td><td></td></tr>
<tr><td colspan="2">2.4.1 The child's nose is more than half their forearm length from the desk OR</td><td></td><td></td></tr>
<tr><td colspan="2">2.4.2 The child's nose is less than half their forearm length from the desk</td><td></td><td></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="2">3.1 One foot is flat on the ground</td><td></td><td></td></tr>
<tr><td colspan="2">3.2 The toes are making contact with the ground</td><td></td><td></td></tr>
<tr><td colspan="4">If neither of the above can be ticked, explain how the feet are positioned</td></tr>
<tr><td colspan="4">Comments from child after giving wedge and instruction on use of same. (Question put to child "how do you feel sitting on the wedge?")</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4"></td></tr>
</table>

Information collected by (AT Trainee Name): **Date:**

Appendix 2

Educational Survey
Impact on pupils' posture of use of wedges on school chairs
4th Class, St Nicholas's Primary School, Claddagh.

Child's Name: **Date:**

Ask the child to complete the following questions and record page 1 observations as they do so.
(If the child needs help completing the form record their answers word for word.)

What do you think of the cushion?	
Do you think the cushion has changed how you sit? If it has list all the ways:	
•	
•	
•	
•	
Would you like to carry on using the cushion?	
Draw a picture of yourself sitting in class	
Before I got the cushion	**After I got the cushion**
What would you be most likely to say about the cushions?	

An exploration of psychological resilience among physicians

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Introduction

Recently published research has demonstrated that burnout is widespread among physicians, and impacts both their wellbeing, and that of patients. Such data have prompted efforts to teach resilience among physicians, but efforts are hampered by a lack of understanding of physicians' perspectives on resilience. This study aimed to contribute to knowledge regarding how physicians define resilience, the primary challenges to resilience encountered, and how understanding resilience in physicians can contribute to patient safety in the healthcare system.

Methods

A qualitative approach was adopted, with 68 semi-structured interviews conducted with Irish physicians. Data were analysed using deductive content-analysis, the framework for which was developed from previous research on resilience conducted by this research group and others.

Results

Five themes emerged from the interviews. The first theme, 'The Nature of Resilience' captured participants' understanding of resilience. Many of the participants considered resilience to be "coping", rather than "thriving" in instances of adversity. The second theme was 'Challenges of the Profession', as participants described aspects of the workplace which threatened their wellbeing and resilience, including long shifts and heavy workloads. The third theme, 'Job-related Gratification', captured aspects of the workplace that support resilience, such as gratification from medical efficacy. 'Resilience Strategies (Protective Practices)' summarised behaviours that participants considered to be beneficial to their resilience, including spending time with family and friends, and the final theme, 'Resilience Strategies (Attitudes)', captured protective attitudes.

Conclusions

Physicians conceptualised resilience differently to typical psychological theories of the concept. This study was unique in exploring the role of the workplace in psychological resilience of doctors. Organisational factors were found play a significant role in threatening physician resilience, and must be considered in future interventions, as it can in turn impact on patient safety in healthcare.

HUMAN FACTORS ANALYSIS OF PRE-HOSPITAL EMERGENCY MEDICAL RESPONSE: FINDINGS FROM IRELAND, CYPRUS AND TURKEY

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Abstract

Introduction

The importance of human factors in pre-hospital emergency medical response is increasingly recognised by emergency medical service (EMS) professionals and their organisations. An emerging body of literature also posits the need to understand human factors (HF) in emergency response (Ross et al., 2015) and crew resource management (CRM) in EMS (Fuefel et al., 2009; Woodson and Bronsky, 2018). Risks to patients and adverse events concern EMS providers. Therefore, this research asks; what are the human factors that affect pre-hospital emergency medical response?

Method

This study employed a mixed methods design involving 307 EMS participants (Surveys=190; Interviews=85; and focus groups=6) from Ireland (N=66), Cyprus (N=55) and Turkey (N=186). Quantitative and qualitative analyses identified HF that affect EMS.

Results

Findings revealed several prominent HF/CRM issues. EMS professionals are highly motivated. They report that saving lives, helping people and serving society are important to them. A strong team ethic was evident in the data. Good information is critical to EMS (e.g. location of emergency, details of casualties, etc.) and this relies on effective communication. Respondents reported stress, often due to limited resources, the high volume of non-emergency EMS mobilisations (e.g. hoax calls) and a pressured working environment. Fatigue due to the nature of EMS work and associated outcomes (e.g. situation assessment and decision making) were reported. Some significant statistical differences were reported between countries.

Discussion

The findings of this study demonstrate the importance of human factors in pre-hospital emergency medical response. The data supports the concerns raised by Fuefel et al., (2009) and Woodson and Bronsk (2018) concerning teamwork, communication, stress and fatigue issues that EMS professionals from each of the participating countries reported. The next step of this research will transform data analyses into knowledge that will support HF interventions for EMS, including CRM training.

Acknowledgements

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A CONSOLIDATION OF HAND HYGIENE GUIDELINES IN THE IRISH HEALTHCARE SYSTEM

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Abstract

Background
Healthcare-associated infections (HAIs) are a major patient safety concern across healthcare services, and optimal hand hygiene (HH) behaviour is considered the most effective strategy for preventing HAIs (Allegranzi & Pittet, 2009). Guidelines, policies and standards for HH have been published by a number of Irish healthcare organisations; however, to date there has been no attempt to consolidate these documents. This two-phase study was undertaken to conduct a document analysis of Irish HH guidelines, and to explore the opinions of key policymakers on the challenges to improving HH compliance in Irish hospitals.

Methods
Phase 1: A systematic search for HH guidelines published at national level in Ireland since 2009 was conducted. Information was extracted on HH indications, preparation, techniques, products and facilities, and strategy recommendations. Four guideline documents met criteria for inclusion in the analysis.
Phase 2: Twelve HH policymakers and stakeholders from healthcare organisations participated in semi-structured telephone interviews exploring the challenges to improving HH compliance.

Results
Targeted healthcare settings and audiences varied across the published guidelines. All four documents detailed HH preparation practices (e.g., clothing and jewellery restrictions) and a majority provided guidance on HH technique. Recommendations were made for audits, education, and patient participation.
Policymakers described a range of existing interventions to improve capability, motivation and opportunities for engagement with HH, along with important environmental facilitators and barriers for HH compliance. Protocols were viewed as having limited impact and understanding of HH best practice, particularly around timing, remains an area for improvement. Simplifications and modifications were suggested and the dual needs for further education and cultural change were highlighted.

Conclusions
Present guidelines in Ireland are somewhat underdeveloped, and while interventions for HH compliance have been implemented, awareness of the importance of HH has not been matched by understanding of best practice. A unified approach to HH at national level is now required to improve compliance.

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THE SAFETY IN PRIMARY CARE (SAP-C) STUDY: A RANOMISED, CONTROLLED FEASIBILITY STUDY

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Abstract

Background
Patient safety research is conducted predominantly in hospital settings, and there is a dearth of knowledge relating to patient safety in primary care, despite findings suggesting that 2.2% of primary care consultations result in a patient safety incident (Gaal et al., 2011). This study therefore aimed to assess the feasibility of an intervention intended to improve patient safety in general practice.

Methods
A randomised pretest-posttest design was employed, with ten general practices (four intervention, six control) in the Republic of Ireland and Northern Ireland recruited. The nine-month intervention consisted of: 1) safety climate survey measurement and feedback, and 2) patient record reviews using a specialised trigger tool (Houston and Bowie, 2016). Outcome measures included; recruitment, response, and retention rates, effects on safety climate scores, and the intervention's perceived usefulness and feasibility as explored via a questionnaire and interview at the intervention terminus.

Results
Response rates were favourable; overall, the questionnaire was completed by 81% (range 42.9%-100%) and 73% (range 57.1%-100%) of practice staff at baseline and study terminus respectively. Changes in safety climate scores, indicating improvement, were observed among the intervention practices but not in the control group. The trigger tool was applied to a total of 188 patient records. Patient safety incidents were detected in 19.14% of reviewed records. Feedback data from practice staff identified the intervention's usefulness in informing practice management and patient safety issues, time as a barrier to its use and the value of group discussion of feedback.

Conclusions

The intervention had a positive impact on safety. Overall, the intervention was considered useful, feasible and sustainable, and worth further investigation in a full scale randomised controlled trial. These data provide an important foundation for further research on patient safety in primary care settings.

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Standardisation for Patient Safety
"A Lean Theatre Anaesthetic Room Initiative"

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Introduction:

Sligo University Hospital has 8 anaesthetic rooms with different drug stock levels and open storage on 3 floors in 4 locations.

Our aims

1. Standardise anaesthetic rooms across theatre complex
2. Reduce drug stock with a minimum and maximum
3. Reduce potential drug errors
4. Comply with Sligo University Perioperative health and Safety document, HIQA, INMO and NMBI GUIDELINES in relation to storage of drugs

Methods:

The Shelving in the Anaesthetic Room contained differing stock levels and the quick access for identifying drugs in an emergency was challenging. Stock levels were measured and a colour coded functionally as opposed to alphabetically was trialled. A feedback sheet was generated from the anaesthetic department.

Results:

Dr Sinead Bredin presented the findings to the Anaesthetic Specialty.

Anaesthetic room shelving reconfiguration: Feedback forms were received from 31 (100%) users, 11 consultant anaesthetists, 12 NCDHs and 8 nurses. 30 or (70%) had used the new layout. 27 (87%) found the layout easier with quicker access, easier to restock and find drugs. 9 (21%) reported having concerns e.g. the position on rarely used drugs and using trade names. Extend to other theatres: Yes 25 (81%) No 6 (19%)

Conclusions:

A business case was approved for the purchase of 9 anaesthetic trolleys (8 anaesthetic rooms and radiology for patients undergoing CT / MRI under anaesthesia) and revamp of anaesthetic rooms.

To sustain the savings

1. Ongoing education for new nursing/anaesthetic staff.
2. Trolleys restocked daily in line with the minimum/ maximum stock levels
3. 6 monthly audit

Project saving applying Lean Principles

Comparisons between stock levels in anaesthetic room	**€ 2,400**
Reduce Stock levels of Bridion immediate savings	**€ 10,000**
Ongoing Bridion Savings	**€ 30,000**
Remove 5 drugs no longer in use	**€ 1,000**
Remove emergency trays and stock drugs on trolley	**€ 1,500**
TOTAL	**€ 44,900**

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Siobhan McEniff Clinical Project Officer, Therese Gallagher ADON Theatres/ Surgery, Grainne McCann CEO SUH, Conor McLoughlin Maintenance Manager, Dr Helen O'Mahoney Consultant Anaesthetist (DSU)

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A STRATEGY TO IMPROVE THE MANAGEMENT OF ERGONOMIC RISK IN THE IRISH WORKPLACE

Frank Power, Health and Safety Authority

Ergonomics recognises that good design of the workplace will take account of the capabilities of the people that do the work. An Ergonomic improvement in a workplace setting removes risk factors that lead to musculoskeletal injury and allows for improved human performance and productivity. The health of workers is not always taken into account in the design or planning of work activities. The evidence suggests that there is still a high prevalence of musculoskeletal injury and ill health in the Irish workplace. The ESRI reported that occupational illness rates have increased from 21.7 per 1,000 workers in 2001 to 27.1 per 1,000 workers in 2012 with musculoskeletal disorders representing over 50% of all occupational illnesses. The increased prevalence of occupational illnesses led the Health and Safety Authority (H.S.A.) to develop a health strategy which includes a focus on managing ergonomic health risks in the workplace. The strategy has three key objectives to increase the knowledge and understanding of ergonomic risk, raise awareness of the value of managing ergonomic risks and ensuring legal compliance through proportionate enforcement. To support the implementation of the health strategy as it relates to ergonomics a number of interventions have been introduced including the roll out of training to inspectors within the Authority on the use of ergonomic risk assessment tools, increased enforcement at workplace level to address unfavourable ergonomic conditions, ergonomic risk assessment workshops for industry to increase the knowledge and understanding of ergonomic risks and methods of quantifying and controlling risk. The Authority continues to develop sector specific guidance and guidance on the need for effective management of ergonomic risk. Effective management of ergonomics risk is essential to address the high rate of musculoskeletal injury and ill health and there are some key factors for its successful implementation and these include, knowledge of the nature of work carried out, effective communication and consultation, use of evidence based risk assessment tools , implementation of appropriate engineering solutions to reduce or eliminate risk factors, transfer of knowledge of new control measures or solutions to avoid or reduce risk and the ability to influence senior management. A strategic approach to managing ergonomic risk will ensure that work activities are designed or planned to avoid or reduce ergonomic risk factors.

BARIATRIC MOVING AND HANDLNG: AN EXPLORATORY STUDY OF THE PROVISION OF CARE

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Abstract

Background. The prevalence of obesity is rising globally, and in Ireland 53% of adults are overweight with 18% classified as obese (CSO, 2016). Persons who are obese are more likely to use health care services (Doherty et al., 2012) and require moving and handling care (Galinsky et al., 2010). However, little is known about the strategies used to provide for this population's specific needs and requirements within the hospital setting. The aim of this study was to explore the frequency and process of providing moving and handling care for bariatric patients in acute Irish hospital settings.

Method. A cross-sectional study design using an anonymous 24-item questionnaire was used to survey all Clinical Nurse Managers (CNM) in the participating hospitals (n=3). Ethics approval was obtained, and a gatekeeper alerted potential participants of the study and provided information on participation. Hard-copy questionnaires were distributed to each CNM. Completed questionnaires were returned by internal post. Data were entered and analysed in SPSS v23.

Results. A total of 61/153 CNMs responded (response rate 39.9%). The majority (92%) had provided care for bariatric patients. Seventy-seven percent reported barriers to establishing bariatric patients' weight, and 89% stated there were barriers to providing patient handling care (Figure 1). The CNMs reported no clear system for ordering bariatric equipment (52%), and a lack of bariatric care guidelines (88%). The majority of equipment was rented, with delays in delivery frequently reported. Only 10% had undertaken specific training and 95% stated they would like bariatric education/training.

Conclusions. To our knowledge, this is the first study of bariatric moving and handling in Irish hospitals. Despite the low response rate and potential self-selecting bias, this preliminary study highlighted the barriers to providing effective bariatric patient care. Lack of equipment, alongside the indeterminate process of procurement or rental of bariatric equipment were identified. Such delays could have an adverse impact on patient care, and require further investigation. The limited clinical guidance is a concern but the enthusiasm for specific bariatric education is a positive finding.

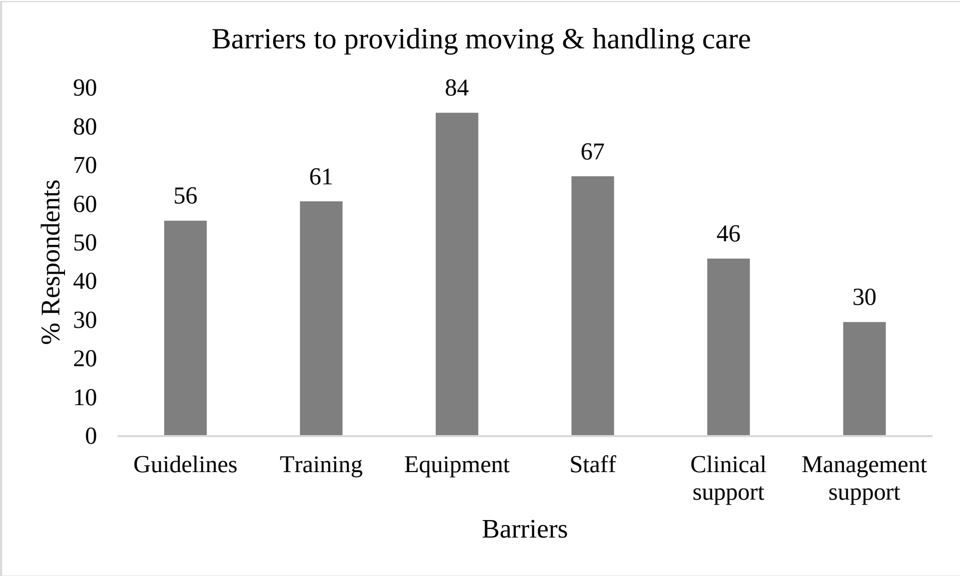

Figure 1. Barriers to providing moving and handling care

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OUT IN THE FIELD:
PERCEPTIONS OF ROBOTIC ASSISTIVE DEVICES BY IRISH OLDER ADULTS

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Abstract

In the coming years, robotic assistive devices such as exoskeletons will become common as a wearable option to assist mobility for people (Young & Ferris, 2016) as they conduct everyday tasks and activities. One such cohort that could benefit from these interventions are older adults. In Ireland, it is acknowledged our population is getting older, with population estimates in 2016 showing over 600,000 adults aged 65+ as part of a national population of approx. 5 million (CSO, 2016). As we age, our requirements to remain independent change, particularly if we experience physical or cognitive decline. This presents challenge to the person, and their extended families and carers. Likewise, the community and health services sector are experiencing new areas of need and focus to cater and offer options to older adults who wish to remain living in their locality and age in place. Robotic assistive technologies can increase, maintain or improve functional capabilities by people with limited mobility. Assistive robot devices can assist in contextual uses involving manipulation, mobility and cognition (Van der Loos et. al. 2008). Technology acceptance by older adults can present challenge to the design intent – to benefit quality of life and adoption of the technology/device. This paper will discuss a study 'out in the field' with 24 older adult participants in Ireland undertaken during 2017. The purpose of this study was to gauge and interpret perceptions towards robotic assistive devices and emerging technologies by the older adult participants.

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