Institution: Loughborough University		
Unit of Assessment: D32 Art and Design: History, Practice and Theory		
Title of case study: Improving Patient and Staff Safety in Healthcare through Human Factors/Ergonomics research		
Period when the underpinning research was undertaken: 2000–2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s):**	**Period(s) employed by submitting HEI:**
Prof. Sue Hignett	Professor of Healthcare Ergonomics & Patient Safety	2001-present
Dr Mike Fray	Senior Lecturer in Human Factors Design	2009-present
Dr Gyuchan Thomas Jun	Senior Lecturer in Human Factors & Complex Systems	2011-present
Period when the claimed impact occurred: 1st August 2013 – 31st December 2020		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact

Around the world, at least five patients die every minute because of unsafe care in hospitals and other healthcare settings, with more than one in ten experiencing preventable harm (WHO, 2019), and almost 500,000 healthcare staff reported work-related musculoskeletal disorders in the UK in 2018/19. Loughborough University's research is used worldwide by healthcare organisations, insurance companies and governments, supporting the redesign of work systems (policies, procedures), equipment (beds, hoists, etc.), space (ambulances, buildings) and incident investigation (applying a systems approach). Specifically, the research has: 1) Underpinned a new European Standard for the manual handling of patients; 2) Reduced injuries for nursing and other clinical staff in 120 countries; and 3) Improved patient safety practices in the UK, USA, Latin America, Australasia, and Asia.

2. Underpinning research

Human Factors/Ergonomics is an applied scientific discipline which integrates design, engineering, psychology, and human sciences to understand complex systems and optimise the physical and cognitive relationship between people, objects, and the environment. To provide high quality and safe healthcare for patients, the work systems and workers need to be operational, efficient, and safe. Poorly designed work systems can lead to staff injuries and errors in patient care. The underpinning research, conducted by a team led by Hignett, which has changed international healthcare safety, is described in relation to both occupational safety to reduce musculoskeletal disorders (MSD) and manage manual handling risks **[R1-R3]** and changing systems thinking (culture/practices) about patient safety **[R4-R6]**.

Occupational safety **[R1]** was conducted with over £11m research funding from EPSRC, AHRC, NIHR, EU Horizon 2020, Innovate UK, government (NHS, DH, MoD, HSE) and industry. The team started nationally, working with the Royal College of Nursing, Royal College of Midwifery, Chartered Society of Physiotherapy, and industry partners to introduce safer systems of work (including new equipment design for beds and hoists); and working with Department of Health Estates & Facilities and Intensive Care clinicians to recommend better hospital building designs.

We then collaborated with colleagues across the European Union (UK, Finland, Portugal, and Italy) to examine the organisational, staff and patient factors of a patient handling system with industry funding **[R2]**. This was one of the first examples of HFE systems thinking to take an integrated approach by addressing both occupational and patient safety. The design of safer work clinical systems includes the product/equipment supply chain, building guidance **[R3]** and socio-technical system design **[R4]**. Fray and Hignett have

received industry funding to test and evaluate innovative equipment for safer clinical care, including hospital beds, patient hoists, and pressure care products. The building design research has looked at a range of acute facility environments, from general medical/surgical wards to intensive care (adult and neonatal), and hygiene facilities (toilets, bathrooms, and sluice rooms).

In 2015 our focus widened to include more patient safety research in collaboration with the Academic Health Service Network (AHSN) Patient Safety Collaborative **[R5]**. Hignett, Fray, and Jun received funding (£159,679) from NHS Improvement and Health Education England to develop and deliver HFE education and collected data about challenges to patient safety **[R6]** and developed the national and international guidance and clinical training programmes reported in Section 4. Finally, the research incorporates and uses our previously created/validated research, including HFE methods and tools; for example, Rapid Entire Body Assessment (REBA) which is taught and used internationally as the foundation for HFE methods and research in many countries **[R2]**.

3. References to the research

R1: Hignett, S. (2003) Intervention strategies to reduce musculoskeletal injuries associated with handling patients: A systematic review. *Occupational and Environmental Medicine.* 60, 9, e6. doi.org/10.1136/oem.60.9. e6.

R2: Fray, M., Hignett, S. (2013), TROPHI: Development of a tool to measure complex, multi-factorial patient handling interventions. *Ergonomics* 56, 8, 1280-1294 doi.org/10.1080/00140139.2013.807360

R3: Hignett, S., Lu, J., Fray, M. (2010) Observational Study of Treatment Space in Individual Neonatal Cot Spaces, *Journal of Perinatal and Neonatal Nursing* 24, 3, 267-273 doi:10.1097/JPN.0b013e3181e8d5c1

R4: Hignett, S., Jones, E., Miller, D., Wolf, L., Modi, C., Shahzad, M.W., Banerjee, J., Buckle, P., Catchpole, K. (2015) Human Factors & Ergonomics and Quality Improvement Science: Integrating Approaches for Safety in Healthcare. *BMJ Quality & Safety* 24, 4, 250-254 doi.org/10.1136/bmjqs-2014-003623

R5: Hignett, S., Lang, A., Pickup, L., Ives, C., Fray, M., McKeown, C., Tapley, S., Woodward, M., Bowie, P. (2016) More Holes than Cheese. What prevents the delivery of effective, high quality, and safe healthcare in England? *Ergonomics* 61, 1, 5-14 doi.org/10.1080/00140139.2016.1245446

R6: Canham, N., Jun, G.T., Waterson, P., Khalid, S. (2018) Integrating systemic accident analysis into patient safety incident investigation practices, *Applied Ergonomics*, 72, 1-9, DOI: 10.1016/j.apergo.2018.04.012. https://www.youtube.com/watch?v=5oYV3Dqe0A8

The research was published in peer-reviewed journals. The work on occupational safety **[R1-R3]** was supported by over £11 million competitively awarded research funding between 2003 and 2019 to reduce manual handling risks to clinical staff with 40 grants from EPSRC, Dept. of Health, National Health Service, and Health & Safety Executive and others.

4. Details of the impact

Our research on occupational safety has been presented at international forums and conferences in the US, Europe, Australia, South Korea, United Arab Emirates, Mexico, Peru, and Canada. It has been adopted by governments and professional bodies **leading to the following impacts.**

Impact 1: Underpinned a new European Standard for the manual handling of patients

In the UK, working with clinical Royal Colleges (nursing, midwifery, occupational therapy) we developed national guidance to improve patient safety and staff safety during care **[S1]** which has achieved impact, being used by **over 560,000** clinical staff. This was used to

develop a **European Standard Technical Report** (ISO/CD 12296 **[S2]**) to establish a best practice baseline for the manual handling of patients across the healthcare sector **[R1, R2]** for **over 4 million** nursing and healthcare staff.

Pathway to Impact 1: Our research underpinned a White Paper from the Chartered Institute of Ergonomics & Human Factors (CIEHF) **[R4, R5]**, co-written with clinicians. It has established the Human Factors/Ergonomics approach to patient safety culture which is now used in the UK **[S5]** and internationally **[S6]** (Mexico (Spanish translation), Australia, New Zealand, USA, Portugal and Peru) and during the COVID-19 pandemic**.** The Head of the Ergonomics Research Centre, Universidad de Guadalajara, Mexico, said:

> *'without your research and our collaboration all these activities and benefits would not have occurred. The value of this … is to provide a clear path … of integrating HFE principles and practices to transform all aspects of our healthcare systems in México and Latin America'* **[S6]**.

The reach of this change in working practice has been extended internationally and been adopted by multiple agencies across multiple geographies. For example, Fray has supported the implementation of government policy in New Zealand with the Accident Compensation Corporation and in the USA with the Ohio Bureau of Workers Compensation **[S8]**.

Impact 2: Reduced injuries for nursing and other clinical staff in 120 countries

The analytics for multinational company AON's insurance for patient handling injuries are based on our research **[R2]** and benefit AON and their clients by reducing volatility and improving performance to achieve financial savings due to a reduction staff and patient injuries. Furthermore, AON **[S3]** has reported a trend of reduced injuries across 120 countries which they attribute to the implementation of the Technical Report for ISO/CD 12296 **[S2].**

To reduce the injury risks associated with working in cramped spaces, our research changed how space in hospital buildings is planned. Our UK research **[R3]** developed the methodology to determine dynamic space requirements for treatment and care and specific design standards, for example: communication and circulation space throughout the hospital (including ward design and space around each bed); intensive care (adult and neonatal); and accident and emergency departments.

Pathway to Impact 2: We raised awareness and increased understanding of how to change safety culture and practice with Human Factors/Ergonomics (HFE) approaches via competitively commissioned 'Taster Workshops' to over 600 clinical staff **[R5].** We delivered training and education to clinical staff and healthcare managers with case studies of changes in safety culture and practice both directly and other media, for example a webinar to over 37 countries **[S6].** The CEO, International Society for Quality in Healthcare (network of health care professionals) said:

> *'if HFE was used routinely as the foundation for interventions in healthcare, then the wellbeing of healthcare workers would be improved. … The attention to the wellbeing of healthcare workers was a focus of the WHO Patient Safety Day recently and that embodied the importance of this research. … You and your team have contributed to our programmes to spread the principles of HFE and the findings of your research'* **[S6].**

Our Taster Workshops have been transferred to an online platform and we are delivering it through Learning Management Systems at NHS Education for Scotland and Health Education England to make this available to over 1.5 million NHS staff.

Our approach was incorporated into the guidance produced by the Center for Health Design, working with the American Institute of Architects (AIA) and Facility Guidance Institute (FGA)

to develop the Safety Risk Assessment (SRA) tool (https://www.healthdesign.org/sra). **This tool is used across the world,** with Hignett providing expert consultancy services, e.g., to the Cleveland Clinic in Dubai **[S4]**. The Vice President for Research, Center for Health Design, USA said:

> *'Our online evidence-based safety Risk Assessment Toolkit, funded through multiple grants awarded by the U.S. Department of Health and Human Services Agency for Healthcare Research and Quality (AHRQ), has a specific focus on these same areas. Your papers become extremely valuable additions to our industry's evidence base* **[S4]**

Impact 3: Improved patient safety practices in the UK, USA, Latin America, Australasia and Asia

Our research has led to **national and international impact** for healthcare incident investigation (HSIB), clinical procedures (AHSN) and influence on strategic focus (with associated allocated budget) for Patient Safety Advisors in every NHS Trust.

Pathway to Impact 3*:* We created a resource, the 'Systems Thinking Video' **[R6]** which has changed attitudes of healthcare professionals and mangers towards the human contribution to safety **[S7].** It was viewed over 20,000 times across over 100 countries, with the resource website being visited by over 5,500 people from 87 countries (over 200 visitors every month). The video was shared through various national e-learning platforms and websites: NHS Education for Scotland; Health Quality & Safety Commission (New Zealand); Clinical Human Factors Group (UK); Korean Society for Quality in Health Care and used by academics and practitioners in medical schools and hospitals around the world for incident investigation and training **[S7]**. As the Professor of Health Policy and Management University of Ulsan College of Medicine, South Korea, reported:

> *'Over 2,000 healthcare professionals and managers in hospitals … attended the KoSQua conference … including … Dr. Jun's … advice on systems approach to healthcare incident investigation to the national body, KoIHA, was very instrumental in improving … current investigation methods for patient safety incidents. … The newly revised methods will help KoIHA to better learn from incidents and make effective changes for patient safety improvement in various healthcare systems in South Korea. and improved the existing investigation methods for serious patient safety incidents'* **[S7]**.

Our research has influenced the planning practices of education and training for patient safety in the NHS which has underpinned the development of a national patient safety syllabus (launched 2020) **[R4-R6]**. The Deputy Director of Patient Safety, NHS England & Improvement said:

> '*The Human Factors for Health and Social Care White Paper enabled a better understanding and supported the foundation for change that we have built into the national Patient Safety Strategy for the NHS … with a strong focus on human factors, safe systems and learning from incidents'* **[S5]**

Further, during the COVID-19 pandemic in 2020 we were requested by AHSN (UK) to improve clinical protocols for use when wearing PPE. The AHSN Patient Safety Director (UK) said:

> *'During the COVID-19 pandemic the Patient Safety Collaboratives,* [we] *launched the National Tracheostomy Programme. A suite of resources were developed to include a set of Human Factors Action Cards for the 3 tracheostomy safety interventions These have been shared [nationally] across all 15 PSCs …* [and] *… to individual hospital trusts. We have achieved 87% adoption of the 3 safety interventions across England.* **[S5]**

5. Sources to corroborate the impact

S1: **Occupational Safety: Manual Handling of Patients UK**
UK best practice guidance 'The Guide to the Handling of Patients' (editions 5, 6 and 7) RCN and other healthcare professional standards.

S2: **Occupational Safety: Manual Handling of Patients International**
Technical Report for ISO/CD 12296 'Ergonomics - Manual handling of patients in the healthcare sector' https://lupin.lboro.ac.uk/viewobject.html?cid=1&id=226757

S3: **Occupational Safety: Reduction in injuries International**
International AON insurance company www.aon.com/about-aon/about-aon.jsp

S4: **Occupational Safety: Building design**
Supporting letter from the Vice President for Research, The Center for Health Design, USA

S5: **Evidence for impact (and pathway) for using Human Factors to improve patient safety practices in the UK.**

- Supporting letters from Deputy Director of Patient Safety, NHS England and NHS Improvement; Safety, Skills & Improvement Research Programme Director, NHS Education for Scotland (NES); Patient Safety Director, Academic Health Sciences Network (AHSN).
- Science in Parliament - invited paper for the Parliamentary and Scientific Committee, UK.

S6: **Patient Safety Practices: International**

- Supporting letters from Head of Ergonomics Research Centre, University of Guadalajara, Mexico; President of Human Factors & Ergonomics Society, Mayo Clinic, USA; Chief Executive Officer, International Society of Quality in Healthcare; Faculdade de Motricidade Humana, University of Lisbon, Portugal.
- Portuguese translation of White Paper

S7: **Patient Safety Practices: Systems Thinking video**
Supporting letters from Vice President of Korean Society for Patient Safety, University of Ulsan College of Medicine, South Korea; Consultant Psychiatrist, Leicestershire Partnership NHS Trust, UK); Consultant Anaesthetist, Salford Royal NHS Foundation Trust, UK); Medical Director, Healthcare Safety Investigation Branch; Performance Improvement Team Manager, Seoul St Mary's Hospital, South Korea.

S8: **Occupational Safety: Manual Handling of Patients International**
Supporting letters from the Accident Compensation Corporation (ACC), New Zealand (Chair of the Manual Handling Association of New Zealand) and the Ohio Bureau of Workers Compensation, USA (Project Lead – Professor of Industrial Hygiene and Occupational Ergonomics, University of Cincinnati).