

## Impact case study (REF3)

<b>Institution:</b> University of Leeds		
<b>Unit of Assessment:</b> 4		
<b>Title of case study:</b> Improving patient safety using a behaviour change intervention		
<b>Period when the underpinning research was undertaken:</b> 2005-2014		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b>	<b>Role(s) (e.g. job title):</b>	<b>Period(s) employed by submitting HEI:</b>
Rebecca Lawton	Professor, Psychology of Healthcare	1999-present
<b>Period when the claimed impact occurred:</b> 2013-present		
<b>Is this case study continued from a case study submitted in 2014?</b> N		
<b>1. Summary of the impact</b> (indicative maximum 100 words)		
<p>Between 2005 and 2011, 21 UK patients died and 79 were harmed during routine medical care because a nasogastric (NG) feeding tube was accidentally placed into their lungs. Reducing these 'never events' (avoidable events that cause serious harm and should never happen) requires clinical staff to change their behaviour: testing pH to identify whether the tube is lodged in the stomach (acid) or the lungs. Researchers at the University of Leeds developed, evaluated and disseminated a method for changing this and other patient safety behaviours. This resulted in 1) safety improvements and cost savings at a regional level, 2) changes in safety knowledge, attitudes and behaviour among 1,300 further NHS staff across England, 3) development of novel innovations for improving the safety of nasogastric tubes.</p>		
<b>2. Underpinning research</b> (indicative maximum 500 words)		
<p>Clinical guidelines often summarise complex and rapidly changing research evidence with the aim of speeding up the translation of evidence into routine clinical practice and reducing unwarranted variations in the quality of care. Consequently, a range of methods have been developed to implement guidelines into routine practice – but, evaluations of these approaches have demonstrated variable effects. This may be explained by the difficulties associated with changing behaviour, especially within complex sociotechnical systems.</p> <p>In 2005, <b>Rebecca Lawton</b> and colleagues used consensus methods to develop a framework addressing professional behaviour change - the Theoretical Domains Framework (TDF) [1]. Further development and validation demonstrated that TDF aids the identification of barriers and levers to organisational and individual level behaviour change [2], which can be subsequently targeted with evidence-based interventions. <b>Lawton</b> and her team undertook further research to develop a method for using the TDF during the implementation of clinical guidelines within a healthcare setting - the Theoretical Domains Framework Implementation approach (TDFI) [3, 4].</p> <p>The TDFI involves a six step process for behaviour change in healthcare: forming an implementation team; defining a locally relevant target behaviour; understanding barriers to performing the target behaviour; devising theoretically informed intervention strategies to address identified barriers; intervention implementation; and evaluation. <b>Lawton</b> and her team demonstrated the feasibility and acceptability of the TDFI approach by evaluating whether it could be used to support the uptake of the National Patient Safety Alert for NG tubes in three</p>		

NHS Trusts in Yorkshire and the Humber [3]. They also evaluated the effectiveness and cost-effectiveness of this approach [4].

NG tubes are used when patients are too unwell to eat and drink or take medicines orally. The tube is inserted through the nose, down the oesophagus and into the stomach. However, from 2005-2011 an average of 20 'Never Events' were reported each year in the UK, where NG tubes were misplaced and feed or medicines were passed into the lung rather than the stomach. The consequences for patients are severe, 20% resulting in death. To ensure patient safety, the position of the tube must be checked before feeding commences. The recommended way to do this is to test aspirate from the tube using a pH paper as the lungs and stomach usually have very different levels of acidity. However, it had become common practice for staff to check the position of the NG tube by ordering an X-ray of the chest. Chest X-rays are difficult to read and over half of the instances of harm caused by misplaced NG tubes were the result of misreading X-rays. **Lawton's** research demonstrated large and significant improvements in adherence to the guideline, from 15% pre-intervention to 56% post-intervention across three NHS Trusts and substantial cost savings [4].

Although **Lawton** and the team demonstrated that it was possible to reduce deaths caused by NG tube misplacement, it was not a failsafe solution because it is not always possible to collect aspirate to allow pH testing. So the research team explored more robust ways of addressing the problem of misplaced NG tubes. Through the University of Leeds Innovation team they were introduced to a group of scientists (Roboscientific) who were using volatiles to develop smell-fingerprints for a variety of agri-food (e.g. food storage) purposes. **Lawton** and her team identified this as a potential method for ensuring accurate placement of NG tubes. Since 2015 they have been working with 'Roboscientific' to prove this concept. In 2018, the team, including Roboscientific, were awarded a £1 million MRC grant (2019-2022) to develop, and do first in man testing of, a new device. Confidentiality issues have precluded publication of this work to date. The team have now developed a sensor array (2020) to distinguish lung and stomach and are currently working with users to design the diagnostic device, which will be ready for testing in early 2021.

### 3. References to the research (indicative maximum of six references)

1) Michie, S., Johnston, M., Abraham, C., **Lawton, R.**, Parker, D., & Walker, A. (2005). Making psychological theory useful for implementing evidence based practice: a consensus approach. *Quality and Safety in Health Care*, 14(1), 26-33. doi: [10.1136/qshc.2004.011155](https://doi.org/10.1136/qshc.2004.011155)

*This paper was based on consensus work undertaken over a year by a large group of clinical, health, occupational and other psychologists. The key contributors wrote the paper, which was then published in the highest impact journal in the field of patient safety. It is highlighted in the MRC guidelines for complex interventions and has been cited 2096 times.*

2) Taylor, N., Parveen, S., Robins, V., Slater, B., & **Lawton, R.** (2013). Development and initial validation of the influences on patient safety behaviours questionnaire. *Implementation Science*, 8(1), 81. doi: [10.1186/1748-5908-8-81](https://doi.org/10.1186/1748-5908-8-81)

*This paper in the leading journal in this field reports on the development of the first questionnaire to assess the behavioural change determinants that most influence the implementation of patient safety behaviours. The questionnaire has since been used as a basis for research beyond patient safety: in breast cancer treatment, adhering to medicines, dietary guidelines, cardiovascular events, etc.*

3) Taylor, N., **Lawton, R.**, Slater, B., & Foy, R. (2013). The demonstration of a theory-based approach to the design of localized patient safety interventions. *Implementation Science*, 8(1), 123. doi: [10.1186/1748-5908-8-123](https://doi.org/10.1186/1748-5908-8-123)

*This paper makes an original contribution to the research field, reporting, as it does, on the development of the TDFI intervention in collaboration with healthcare staff. The methods described in this paper are those adopted as the basis for the NHS training (see Section 4).*

4) Taylor, N., **Lawton, R.**, Moore, S., Craig, J., Slater, B., Cracknell, A., & Mohammed, M. A. (2014). Collaborating with front-line healthcare professionals: the clinical and cost effectiveness of a theory based approach to the implementation of a national guideline. *BMC health services research*, 14(1), 1. doi: [10.1186/s12913-014-0648-4](https://doi.org/10.1186/s12913-014-0648-4)

*This paper provided essential evidence to make a strong argument that adopting the TDFI approach had the potential to increase safety while at the same time reducing costs.*

### Grants

Between 2011 and 2016, Rebecca Lawton was Principal Investigator on three grants that supported the research described in the case study. This research was innovative, robust and highly relevant to the service need making it possible to obtain funding from a variety of sources:

[i] The Regional Health Authority £230,000 from 2011-2013; ii) NHS Improving Quality £45,000 in 2015; iii) The Academic Health Science Network (AHSN) and Collaboration in Leadership in Applied Health Research and Care Yorkshire and Humber (CLAHRC YH) Innovation fund - £30,000 in 2014-2016.

In 2018, Angela Grange, Lead Nurse at Bradford Teaching Hospitals Foundation Trust, one of the Trusts who participated in the previous NG tube research, led a successful £1 million bid (**Lawton** as co-Investigator) with Roboscientific to MRC Developmental Pathway Funding Scheme to support the development and evaluation of a new device (NG-Sure) for checking the correct position of an NG tube.

### 4. Details of the impact (indicative maximum 750 words)

The research described above has produced a broad range of impacts including changes in 1) safety outcomes and cost savings at regional level 2) changes in staff knowledge, attitudes and behaviour at regional and national level 3) Innovations for improving the safety of NG tubes that have led to commercial impact for the companies involved.

#### 1) Safety outcomes and cost savings at regional level

In three collaborating NHS Hospital Trusts in Yorkshire and Humber, our research [3, 4] demonstrated a large and significant increase in pH testing first line (from 15% in 2011 up to 56% in 2012) and a related decrease in X-ray use (from 59% down to 24%). We estimated savings (from reduction in X-rays and 'Never Events') and costs (implementation of the intervention) in the first year were £2.56 million and £1.41 million respectively, resulting in net savings of £1.15 million. Implementation continues, and in our largest collaborating NHS Trust, use of pH testing first line has been sustained (from 12% in 2012 to 85% in 2019), along with a decrease in X-ray use first line (from 75% in 2012 to 8% in 2019). This contributed to the Trust going 2000 days between nasogastric never events (from 2013 to 2018). Previous to this there had been three never events in a period of 18 months [A].

The fundamental role our research played in improving safety has been confirmed by the Associate Medical Director for Quality Improvement at Leeds Teaching Hospitals NHS Trust:

*"The TDFI approach allowed us to identify the key barriers within our Trust (and two others in the region) to carrying out the correct behaviour for placement of nasogastric tubes by checking pH first line. Rebecca's research was integral for providing evidence that, if we wanted to improve safety, we had to improve the culture and behaviours in our organisation. It is likely, if we relied on training alone, as we had done previously, we would not have seen the same reduction in never events. This work has saved lives [A]."*

The success of this approach for implementing a national patient safety alert subsequently affected the way advice has been issued nationally [B]. Deputy Director of Patient Safety (Insight), NHS England and NHS Improvement said:

*“Rebecca understood the challenges we faced in national implementation of patient safety alerts and recognised the potential of positive outliers within healthcare organisations in improving patient safety, as seen in the successful uptake of the NG alert. This helped our own thinking around the value of a positive deviance approach in informing our improvements in how we issued advice. Rebecca’s research journey in patient safety is one that was very attuned to national needs and I’m sure subtly influenced what we did nationally [B].”*

## 2) NHS staff knowledge, attitudes and behaviour

The success of this approach to change behaviour for patient safety [1-4] led directly to the development of Achieving Behaviour Change (ABC) training workshops for NHS staff. These workshops were designed so that staff could learn about and use the TDFI approach in their own clinical setting. These workshops were commissioned by Academic Health Science Network for Yorkshire and Humber, Improvement Academy and later, NHS Improvement and NHS England. To support this, a behaviour change toolkit was developed and made available free of charge via the Improvement Academy website [C], together with a brief summary of the underpinning ideas and research in an animated video. This tool has helped to develop a culture of safety within the NHS and improve safety practices across the UK.

From 2014-2019, the Improvement Academy delivered 21 regional workshops across Yorkshire and Humber (1200 delegates) and 4 national train-the-trainer workshops (Leeds, Birmingham, London x 2) (160 delegates). Feedback has been excellent (Mean score of 4.5 out of 5) and many clinical staff have gone on to use the approach to deliver patient safety improvement projects in their own organisations [D]. Notable examples include:

In 2017, a Trust worked with the Improvement Academy on a project using the TDFI methodology to understand barriers to delivery of the one-hour sepsis bundle [E]. The insights generated from this project enabled the Trust to develop a comprehensive action plan and logic model to help the sepsis quality improvement team plan and implement the changes needed to overcome these barriers. In 2019, the Improvement Academy worked with a mental health provider to apply the TDFI method to the problem of substance misuse on their acute psychiatric in-patient areas [E].

These workshops continue to be delivered by Yorkshire and Humber Improvement Academy who have now integrated the ABC approach into their Quality Improvement training offer and delivery of the national Patient Safety Collaborative priorities.

According to the Director of the Yorkshire and Humber Improvement Academy:

*“The work of Rebecca’s team has enabled the Improvement Academy to become truly cutting edge in terms of how we are able to support frontline staff to improve the safety of patients across Yorkshire and Humber. This work has transformed how we view quality and safety improvement, and this continues to influence a generation of safety improvers [F].”*

The success of this work led to the invitation of **Lawton** to give a keynote at the 5<sup>th</sup> Global Ministerial meeting on Patient Safety in Montreaux in 2020, to present the TDFI approach for achieving behaviour change in healthcare organisations to health ministers from across the globe.

## 3) Novel innovations for improving the safety of nasogastric tubes

The work has led to further spin-out projects, including the development of an award-winning NG Tube Safety Pack by one of the junior doctors who we worked with. The main idea behind the pack is a green–amber–red traffic light prompt card system that makes guideline recommendations accessible, concise, and easy to follow. The pack also contains a process

documentation sticker for patient records, a summary of the insertion process, checks for X-ray reporting, and basic equipment, all of which can be used across different hospitals.

This pack was designed and developed by GBUK Group, who launched the pack in the developing hospital, which purchased 1,000 packs in August 2013. Since the launch, GBUK has sold over 950,000 NG tubes containing the NG safety literature across the UK [G]. It has approximately 40% of the NG tube market share in the UK, representing a significant reach throughout the NHS.

The GBUK Group Head of New Product Development said:

*“Rebecca and her team’s involvement in the development of the Safety Pack, incorporating key human factors and medical device design principles, undoubtedly will have contributed to improving the reduction of never-events around NG tube misplacement within hospitals in the UK [G].”*

We are currently delivering a project to develop a novel NG tube with RoboScientific (a spin-off company of University of Leeds) that can accurately identify the position of the tube without the need for aspirate (which is impossible to obtain in about 25% of cases). With seed-corn funding via the AHSN and CLAHRC we tested the proof of concept of an innovative method for assessing the correct positioning of a nasogastric tube. Based on the success of this proof of concept, in 2018 we were successful in attracting £1 million of funding via the MRC Development Pathway Funding Scheme to further evaluate our approach.

#### **5. Sources to corroborate the impact** (indicative maximum of 10 references)

- A) Testimonial from Associate Medical Director for Quality and Improvement at Leeds Teaching Hospitals NHS Trust outlining safety and cost savings at a local level.
- B) Testimonial from Deputy Director of Patient Safety (Insight), NHS England and NHS Improvement, describing how this work has influenced national policy
- C) Improvement Academy Website where resources are held.
- D) Workshop feedback available on request.
- E) Testimonial from Patient Safety Collaborative Programme Manager of the Improvement Academy outlining notable examples of where NHS staff have used ABC training to deliver patient safety improvement projects in their own organisations
- F) Testimonial from Director of Yorkshire and Humber Improvement Academy highlighting how they have used the Achieving Behaviour Change approach in Quality Improvement and Coaching across the region and in delivering specific projects as part of the NHS England Patient Safety Collaborative.
- G) Testimonial from GBUK Group Head of New Product Development outlining involvement in development of Initial Placement Nasogastric Safety pack and number of units sold