Human factors for Digital Health

Healthcare

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An exploration on how to reduce the cost of medical error through the adoption of digital health tools

By PDD's Healthcare team

Recent statistics issued by the National Academy of Medicine show that diagnostic error has been labelled number one in a Top Ten list of patient safety concerns.In their 2015 report, Improving Diagnosis in Health Care, the academy stated that most individuals 'will experience at least one diagnostic error in their lifetime'. There are many potential causes for such errors including the complexity of the diagnostic process, the system that surrounds it and the way that multiple providers need to work together to deliver healthcare. Human Factors come into play, for example the cognitive biases that are inherent in medical decision-making and problem-solving.

Arthur Elstein, a cognitive psychologist keen on understanding "how doctors think", has been studying diagnostic thinking and medical problem-solving throughout his career. He has concluded that diagnosis tends to be inaccurate 10-15% of the time. This fits into a much broader picture of concerns regarding medical error. For example, a systematic review found that the probability of at least one error during the preparation and administration of an IV medication was 0.73. More details here.

Image credit: Pexels

Other statistics include:

- 5% of hospitalised patients are suffering from adverse drug effects every year (Pirmohamed et al., 2004).

- Medication errors happen in nearly half of all surgeries, according to Massachusetts General Hospital (Tozzi, 2015). More information here

Reducing the cost of medical error

There is an opportunity to reduce the prevalence of error through the adoption of digital health tools. These tools can be deployed to reduce error against a backdrop of rising costs and growing expectations. It follows that costs associated with healthcare expenditure are rising faster than the GDP and economic pressures are aggravating the situation. Moreover, macroeconomic elements, such as the ageing population and/or shortages of public funding are putting additional pressure on the system.

In this climate we can't afford the cost of medical error (in addition to the unquantifiable personal cost). Digital health tools not only provide the opportunity to make things safer but also support increased efficiency. These tools provide the potential for global impact – for example, although the overall demand for healthcare varies according to every country, there is an increasing need for medical support in most regions. Across the Globe, thanks to medical advancements and a growth in medical understanding, people are living longer but also suffering from chronic diseases for longer.

Human Factors and Digital Health

Human Factors and Ergonomics contribute towards Digital Health by providing an understanding of the healthcare system, making sure we get the right tool for the job and that the tool is fit for purpose. Human Factors researchers also act as integrators across the myriad of disciplines that can support improvement. Based on principles aimed at optimising human performance through the understanding of behavioural patterns, this type of research provides the opportunity to build on contemporary patient safety and quality-enhancement science, providing an efficient and consistent approach to achieving clinical excellence. Acknowledging human limitation is a crucial step in identifying and preventing patient safety risks, as well as providing corrective actions. A wide range of the most critical challenges faced by the healthcare sector, including mistakes in labelling, incorrect dosage and documentation errors can be diminished through an effective use of technology (tools designed to prevent error).

At the same time, it is important that this technology is designed to optimise Human Factors. For example, when clinical staff at a hospital near Washington D.C. misunderstood a pop-up box on a blood-sugar reader, they wrongly gave insulin to a patient with low blood sugar, which eventually caused them to go into a diabetic coma (Nichols, 2011). Later investigations pointed out that previous customisations to the glucometer made by the hospital staff led to the error that could have been fatal to the patient.

Human Factors research would not only seek to understand how the design of the technology could be improved to reduce the chance of this occurring, but would also seek to understand the underpinning root causes and process of adaption and re-configuration within a hospital. We therefore seek to understand the tools that people use, adaptions and workarounds, alongside the environments in which people live and work. This allows us to control the use of technology and build theories and frameworks that allow us to work with clinical processes and problem solving rather than against them.

One common misconception is that new technology is designed to automate, standardise or reduce human involvement in healthcare. This is not the case – Human Factors research often supports team working initiatives and we acknowledge that it is crucial for the medical staff to receive the needed training on how to use new technology. In addition, HF researchers also acknowledge and accept that quick implementation of new medical technology has potential to lead to adverse patient events, especially when it is not entirely

Image credit: Pexels

integrated into the workflow (regardless of the extent to which it has been designed to support it). Testing new prototypes in controlled environments rarely takes into consideration people's actual behaviour when facing critical real life-threatening scenarios (real-world use). Human Factors research therefore overlaps with systems engineering approaches and aims to "get real" in terms of taking into account the integration within the work environment.

Even though human error cannot be entirely eliminated, it can be monitored and moderated and digital health tools play a central role in this endeavour. This is because they can overcome some of the aforementioned cognitive biases; they can be used to support decision-making and give capabilities that medics would not otherwise have (for example review of medical records, diagnostic results and reference data); they support improved tracking and analytics. To show what we mean, here are some examples of innovation in this area:

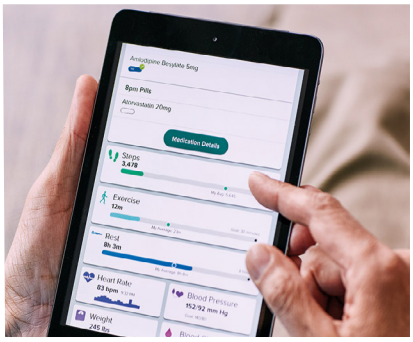
Smart packaging solutions launched by Schreiner MediPharm and ECCT (Experts in Communications & Connectivity Technology)

Although medication adherence is important regardless of the context, it is particularly important for clinical trials where the outcome of the activity is used to inform decisions that have wide ranging repercussions. Tracking and addressing adherence can reduce the need for larger sample sizes and avoid "false negatives" e.g. outcomes where efficacy is called into question but is simply a result of people not taking the drug.

Smart packaging solutions have been developed where the act of pressing a tablet out of a blister pack creates a digital trace that can be uploaded to a database via a smartphone app. Compliance can be facilitated and it is also possible to send an automated reminder should individuals "lapse" and not take the medication. These solutions can be used to facilitate patients' medication intake, as well as improve the accuracy, efficacy and speed of clinical trials. They can be used to overcome lapses in memory or compensate for changes in routine or lifestyle factors that may impact on adherence.

The 'digital pill' proposed by Proteus Discover can monitor a patient's health statistics and changes in real-time. The pill works by relaying physiological signals once consumed. Apart from the ingestible sensors, this innovation also includes a sensor patch, a mobile phone application and a provider portal. This provides unprecedented access into patients' health status which can be used to assess treatment effectiveness. Innovations like the smart pill provide the potential to personalise and modify treatments.

They also supply a safety net in terms of the potential to provide alerts and alarms should a condition deteriorate. This type of solution can be used to improve diagnosis (i.e. by providing information that wasn't previously available). Should mistakes occur then providing a real time physiological feed is likely to increase the chances of and error being detected before it gets serious.



The Digital Pill launched by Proteus Discover

An increasing number of healthcare providers are spending increasing amounts of time in front of their computers performing administrative tasks. They are spending less time interacting with patients. AugMedix aims to simplify the process of using Electronic Health Records (EHRs) to "re-humanise the doctor and patient relationship." The growing prevalence of EHRs is significantly adding to the clinician's workload as it shifts the process of data entry onto them. Less time spent with patients has the potential to reduce diagnostic accuracy, patient satisfaction and clinician job satisfaction. Augmedix uses Google Glass to enable doctors to record and access data such as photos, notes and personal details related to patients from the EHR.

This can improve the doctors' consultation process, as they get more time to physically interact with the patient instead of spending time logging in their computerised files. Human Factors researchers have been studying ways to optimise the data entry process (alongside speed accuracy trade-offs) including the impact of new data input methods (such as touchscreens and wearables). Although there is no silver bullet regarding the process of capturing and communicating a medical ground truth, considering ways to get more for less in terms of reducing the burden of maintaining accurate records is likely to provide significant benefit.

Conclusion

Medical professionals have been pioneers of new technology for many years. Digital Health has the potential to build on this work but, at the same time, needs to acknowledge the human elements of the system. This comes against a backdrop of technological change, rapid advancement in medical understanding and growing pressure on resource. Technologies that provide support and assistance are likely to result in benefit, reducing the potential for poor quality decisions and providing safeguards for patients and healthcare staff.

The ubiquitous nature of modern technology makes it well suited for providing embedded support – i.e. acting as an aide memoir or reference when required. Take for example the growing use of healthcare apps – in this case mobile applications are enabling users to connect to AI robots that will eventually provide information on diagnosis, treatments and provide training if required. There is also the opportunity to extend the use of this technology to address societal concerns – for example monitoring, alerting and alarming to reduce the potential for (large scale) error and supporting patients' well-being through improvements in diagnosis and reduction in sub-optimal treatment.

Image credit: Augmedix Glasses

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Chris has experience of conducting formative and summative usability studies across a range of medical devices. He has experience across healthcare, defence and aerospace.Before joining PDD, he spent five years working on the EPSRC funded CHI+MED research project, investigating ways to make medical products safer.

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