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Symptom and Lifestyle Tracking

T.A.Dawson

***Abstract*— THE healthcare industry is undergoing transformational change with a massive drive for standardized communication systems, robust security, improved efficiency and increased accountability. In addition to this, there have been major and rapid advances in medical sensing and mobile communications devices with advances in functionality coupled with improvements in portability (miniaturization and power efficiency). There have also been unprecedented advances in objective technologies across the board and specialties especially in the areas of imaging and laboratory analysis. Whilst all these advances have been going on, this technical culture has, for the most part been effectively neglecting the most important reason for medical presentation and intervention, being the story as told by the patient. Some tools have been developed to address this but they generally require a reasonably high degree of literacy to make full use of the applications. To address these issues we are developing a communications system that utilizes symbology, or icon-based communications, coupled with single words or simple phrases (in a variety of languages). When used on mobile communications devices, subjective experiences can be recorded in, or near to, real-time addressing another communication issue, that of memory. Additionally, intensity data can be recorded and the entry time and geolocation stamped. The hope is that this technology will reinforce the importance of the patient's story, as told by the patient. This technology has been designed to be patient-centric and to empower individuals and populations of individuals in communicating their stories.**

***Index Terms*— Medical communications systems, mobile technologies, IT, tracking, healthcare, telemedicine**

MEDICAL COMMUNICATIONS

Clinical professors universally reinforce the importance of patient history in medical diagnostics and monitoring. Medical history is acknowledged by most healthcare professionals to supersede the importance of examination, imaging and laboratory investigations. Without an accurate recall and transcription of events, the accuracy of medical diagnosis can be critically compromised. For example, an individual who is breathing with difficulty, and is red and blotchy and cannot remember eating a peanut 30 minutes earlier will compromise the physician's diagnosis of a nut allergy and may lead to the individual not avoiding nuts and having the same potentially life-threatening problem in the future.

In addition, physicians rely on patient feedback on efficacy of interventions, reporting of adverse effects and progression of disease. Due to treatment and individual variability (resulting from a myriad of factors including genetics, nutrition, lifestyle and history) the response to any one intervention is variable and thus feedback is extremely important. For the treating physician, monitoring this response occurs mainly at the post-prescription appointment. This can be problematic because there

can be a significant delay or error in reporting adverse effects or lack of efficacy due to elapsed time between appointments resulting in decreased likelihood of an accurate recall of events.

This reliance on the individual's 'story' is of importance because it relates directly to the problem that precipitated the person's first visit to the health care provider. There are, however, problems with this reliance on doctor/patient communication as human memory is fallible and there can be variable delays between reporting and the actual time of the course of events leading up to the appointment. It is well established that recall of events can be inaccurate,[1] and this is even more of an issue in certain medical conditions such as a head injury[2].

As well as memory, bias at the time of any professional consultation due to literacy, general communication skills, language, cultural, ethnic and social economic barriers also impede effective communications between individuals and their medical health care provider(s).

In addition to the above, there are potentially multiple transcription errors (at the healthcare provider level) from other factors including preconception, leading and closing questioning, time pressure, and a general misunderstanding.

There has been increasing recognition of the fallibility of conventional healthcare provider/patient communications and a variety of solutions have been proposed. With the increasing penetration of both the internet and mobile technologies, academic researchers and commercial entities have found this technical arena a potentially good solution space for all of the above issues.

The solutions proposed have revolved around tracking symptoms[*] utilizing desktop or mobile hardware for input through a variety of user interfaces.

There are a number of limitations in the widespread usability of such technologies:

1. User input generally requires some knowledge of how to use the technologies with keyboard entry.
2. The instructions and guidance also utilize written text, thus failing to be usable by those with disabilities or language difficulties.
3. There is a lack of decision support built into the current applications.
4. The tracking areas are currently very focused, so the benefits are not available to the population at large.
5. Only a small proportion of the groups working in the field have incorporated the input into an open source format for more universal medical record integration.

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[1] Bravo BN, Postigo JM, Segura LR, Selva JP, Trives JJ, Córcoles MJ, López MN, Hidalgo JL. Effect of the evaluation of recall on the rate of information recalled by patients in Primary Care. *Patient Educ Couns.* 2010;81(2):272-4.

[2] Goverover Y, Chiaravalloti N, DeLuca J. Pilot study to examine the use of self-generation to improve learning and memory in people with traumatic brain injury. *Am J Occup Ther.* 2010;64(4):540-6.

[*] For the purposes of this document a symptom is defined as any subjective feeling that an individual can experience that has a range from normal to abnormal, or typical to atypical. This range can be continuous, intermittent or binary (yes or no).

TECHNICAL SOLUTION

To address the issues described above we have designed a technical solution with the purpose to enhance communications between patients and their providers. To minimize barriers, it utilizes a single or double word (multiple language insertion capabilities) and single icon identifier of symptoms (icons are modifiable depending upon user or user group preference), linked to an intensity scale - this is automatically time-stamped and can be enabled, depending on the communications hardware, to provide geolocation information as well.

Our hope is that this technology will be widely adopted, becoming a powerful and cost-effective tool for data collection for communication, record, audit, and enhanced clinical decision-making through combined data display or by running decision support algorithms on the data (Figure 1). Each symptom entry is a useful data point that, when combined with other data (biometrics, location, other symptom entries) can inform on population, sub-population and individual behaviors.

Figure 1

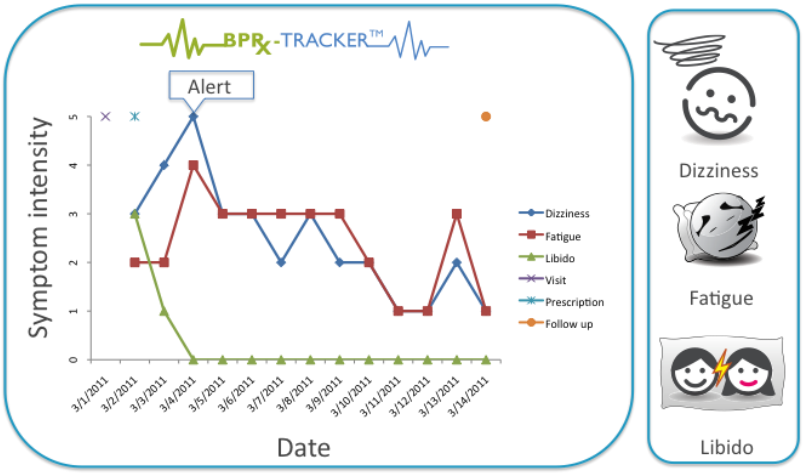

Figure 1: shows an example blood pressure medication tracker (BPRx-tracker) as it might appear on a medical provider's screen at the time of consultation. Subjective feelings (symptoms) are rated daily from 0-5 on a sliding scale. This fictitious example illustrates how a provider may follow symptoms they are especially concerned about after prescription of a beta-blocker (blood pressure medication) at the visit on March 1. The patient filled the prescription on March 2 and started tracking their symptoms. They rapidly became dizzy to a potentially dangerous level on March 4 and the clinic was automatically notified. This gave the clinic staff the opportunity to ring the patient to check how they are doing. At follow-up on March 14 the patient said they were absolutely fine however the prescribing physician knew from the previous data entries that they were not mentioning the problem with their libido as well as the severe dizziness and fatigue soon after prescribing. This information might be used to alter prescribing practices, minimize adverse reactions and enhance treatment.

We are also developing lifestyle trackers for activity and nutrition using the same simplified icon-based system. It has been established that people who enter lifestyle information develop improved lifestyle habits. It is also recognized that compliance for such data entry can be low, due to a variety of barriers such as ease of use, and

time taken. In addition to obtaining extra data it is expected that those who use the technology to track their lifestyle behaviors and symptoms will have overall better health outcomes compared to those who do not.

Icon validation studies are in their design phase and are following a three-tier strategy for cross validation of icon "meaning". Tracking activity can be validated with cross-referencing inputs from accelerometer and/or heart rate monitor data. Tracking nutrition can be validated by comparing activity, nutrition inputs and weekly weights and algorithms have been developed for this purpose.

Validation of the system itself needs to be based around compliance, willingness of use and health outcomes. Studies to address these factors have been designed for asthma, diabetes and obesity.

CONCLUSION

We have designed an icon-based medical communications technology to enhance health provider: patient interactions and decision making, whilst empowering individuals. The solution set has been designed with an open source output so it can be incorporated into a variety of other medical data, decision support or networking interfaces. It can be integrated with medical device outputs to provide a more holistic healthcare package providing extra scope for improved community care, potentially reducing travel, clinic visits, medical interventions and hospitalization. It is our intention to work with collaborators within academia, government and industry to further develop this technology with the end-goal being improved individual and population health whilst reducing the cost burden of gold standard healthcare.