

Background

Since 2010 the UK National Cancer Patient Experience Survey (CPES) has been sent over a 3-month period each year to all patients treated for cancer as in-patients or day cases in NHS Trusts in England. But currently there is no way of systematically, efficiently and usefully analysing and reporting the 70,000+ free-text responses in these surveys. Manual thematic analysis can take months and template-based machine still requires most of the data to be analysed manually. More consistent use of survey free-text data would provide insights into the closed question responses.

Aim

We therefore used rule-based machine learning to structure CPES free-text comments, with the rules drawing on healthcare domain-specific gazetteers of terms. We explored this for cancer as a specific condition, with transferability to other healthcare free-text feedback data and conditions also explored. Our main aim was to improve the use and usefulness of patient experience survey free-text comments in driving health service changes.

Methods

Rules were developed using the Welsh CPES data from 2013, and stakeholders' (patients, carers. Healthcare professionals, commissioners) views on the themes as explored in group concept mapping workshops. We validated the rule-based machine learning work by running through the system the 50% of Welsh CPES not used in our development work, and compared results against manual analysis of the same data. We considered statistics on sensitivity, precision, accuracy and F-scores. In the same way, we validated against two further datasets to explore transferability without modification, one from patientopinion.org and one from a patient reported-outcome-measure prostate cancer survey.

Results

From the workshops we found that different stakeholders had different understandings of salient themes. All twenty-six participants rated themes by feasibility and 25 by importance; scores were similar for both, suggesting participants conflated them, with a Pearson's correlation coefficient of 0.95. The top themes by importance for patients and carers were: Legal and safety issues; Staff attitudes; Staff team work; Diagnosis and primary care issues; Funding and resources for the NHS; and Facilities and environment of the hospital. For healthcare professionals they were: Legal and safety issues; Staff training and skills; Facilities and environment of the hospital; Staff attitudes; Team work/communication; and Including patients' family in treatment and decision making.

We calculated the following statistics for WCPES data comparing our rule-based machine learning with manual analysis of the same date: Accuracy = 86%; Precision = 88%; Sensitivity = 96%; F-score=92%. Automated performance with patientopinion.org and a patient-reported-outcome-measure prostate cancer survey was poor; this was a test to see if the system could give reasonable results with other data sources without any modification which it cannot. However the system has been designed to be easily modified for other data sources. Accuracy testing with modifications is continuing and may be augmented with other types of machine learning.

Conclusions

This study provides proof of concept for an approach that could automate the aggregation of patient feedback free-text data into themes. We have achieved the potential systematisation of patient

experience free-text comments in a way that should drive healthcare improvements, with process transferability inbuilt. Our work shows that such novel interdisciplinary research as ours is needed and has considerable benefits. We believe our proof of concept is the first attempt of its kind in healthcare. Importantly, we have used a modular approach that can be easily adapted for other surveys and other disciplines, with supporting documentation. Nonetheless, further work is required to develop this work beyond the current prototype or pilot design, and to embed the approach routinely within healthcare processes. Our approach has shown that routine adoption within healthcare of careful automated analyses of free-text, and a move from annual to real time feedback models is possible, once the process is refined and barriers to its use (such as governance issues) become resolved.