Harnessing knowledge AND clinical experience to improve patient care employing an electronic system analyzing non-structured medical records: The “SimRec” Software

Authors: Nicolas Woitzik, Roland Mertelsmann, Reinhard Marks

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Affiliation: Medizinische Fakultät, Albert - Ludwigs Universität Freiburg im Breisgau, Germany

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Abstract:

The era of digitization reached the medical field. Technological advances and growing access to computer systems drive many health care innovations. In 2009, the United States authorized the Health Information Technology for Economic and Clinical Health (HITECH) Act. It aims to create a 21st-century health care information system. One important step to achieve this goal is the expansion and adoption of electronic health records (Blumenthal 2010). These records consist of different patient characteristics, for example, diagnostic tests, like blood tests as well as social information. Computerized clinical decision support systems (CDSS) use this electronic information to evolve recommendations for the health care staff.

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Nicolas Woizik, Roland Mertelsmann, Reinhard Marks

Uniklinik Freiburg

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system was developed, called “simrec” (Hummel et al. 2018). It uses information retrieval methods to find automatically similar doctor’s letters to a given patient and provides a similar patient case out of a database to include this information into the users decision-making process. As a first step, the system was tested on a small dataset of approximately 300 free text oncology letters for some exploratory work. This dataset contained patients with different oncological diseases. As we expected, that it should easy for the program to differentiate between this patients we conducted a second, psychological experiment to validate the correlation between the computed similarities by the new CDSS and the similarity judgment of medical experts, junior doctors and medical students (Woitzik 2019). For the verification, our new dataset contained 489 anonymized patient’s discharge summaries, all having chronic lymphatic leukemia in common. The participants rated the similarity of letter pairs, using a seven-level rating scale. Each of the 20 “reference letter” was compared to five “similar letters” (the 4 best fitting letters according to the algorithm and a random letter). Fife participants per group (experts, junior doctors, and students) took part. We expected that experts rate similarity between patients or rather their discharge summaries in a way that correlates with the computed similarity of the system. We assumed that the more experienced a participant is, the higher is the correlation. We could show that for this bigger, more homologs dataset the computed similarity correlates with the expert rating (Spearman correlation 0.512 (95% CI: [0.387, 0.637])). The experiment confirmed the already demonstrated superiority over chance (rating difference between best fitting letter and random letter 1.76 (95% CI: [1.14, 2.38] for experts). Furthermore we investigated differences between the three groups. The correlation was higher for experts than for assistants (0.443 (95% CI: [0.318,0.568])) and students (0.439 (95% CI: [0.314,0.564])), but no significant difference could be found. Additionally, we asked participants to fill in a questionnaire for explorative analysis to gather information about future application areas in working life or for medical issues, as well as possibilities for improvement. Taken together, the retrieval system offers similar and appropriate patient cases even for a bigger and more homogeneous dataset. It confirmed its superiority above chance but no significant differences between different groups of potential users

could be found. Our explorative work showed that the participants can imagine working with such a program for different interest, depending on their professional status. In the future we will ask doctors to use a prototype during their day-to-day working life. As with any CDSS, the recommender program has to be further evaluated before it can be integrated into clinical practice, as the effects of CDSSs on patient health often remain unstudied(Garg et al. 2005). Another issue that should be faced is the anonymization process to guarantee data security. The system still needs improvements, either based on an improved retrieval algorithm or by additional features. However, it is likely that the performance of the system will improve the more discharge summaries a database contains like it was shown in the experiment. Our data suggest that the simrec software might indeed become an important clinical tool to share clinical experience between hematologists and possibly also other medical specialties. However, the patients' perception of such a system and recommendations based upon it should not be overlooked and remain to be studied.

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