Usefulness of a Medical Interview Support Application for Inexperienced Physicians

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Abstract

Background

Medical interviews play an important role in disease diagnosis. Medical interview education and clinical experience are required to perform an appropriate medical interview; however, not all medical staff can perform medical interviews at the same level. This study examined whether a medical interview support application could enable physicians with little clinical experience to perform highly accurate medical interviews.

Methods

Fifteen junior residents (less than two years of post-graduation) performed medical interviews with 20 cases portrayed by simulated patients. In 10 cases, a medical interview support application was used. After the medical interview, the participants were asked to list about 10 differential diagnoses. The interview was considered appropriate if it included the disease portrayed by the simulated patient.

Results

The use of a medical interview support application increased the percentage of appropriate medical interviews. Considering the frequency, the use of a medical interview support application increased the rate of appropriate medical interviews in the rare disease group. It also increased the number of questions and the duration of the interview. No stress-reduction was observed.

Conclusion

The medical interview application may be a useful tool in identifying appropriate differential diseases.

Background

When an untrained doctor practices the traditional way of learning medicine described by William Halstead in 1904 as “see one, do one,” it increases the patients’ risk [1]. Medical malpractice is one of the causes of death [2, 3]; therefore, medical care based on “trial and error” cannot be an option [4].

In actual clinical practice, medical interviews, physical examinations, and results such as images contribute 76%, 12%, and 11%, respectively, to a diagnosis [5]. Medical interviews play an important role in clinical diagnosis and treatment. It is important to list several differential diseases through appropriate medical interviews [6]. When no differential disease is expected, the accuracy of the evaluation of physical findings decreases and the possibility of missing abnormal findings on examination increases [7, 8]. Since medical interviews are the basis for appropriate physical examination, selection of

appropriate examinations, and appropriate interpretation of results, it is necessary to improve medical interview skills for an accurate diagnosis. However, improving medical interview skills requires medical interview education and clinical experience [9]; therefore, medical staff cannot perform accurate medical interviews.

To solve these problems, diagnostic support tools have been developed worldwide in recent years [10–12]. Although there are applications that support medical interviews [13], there are no studies on their clinical effectiveness in PubMed (as of February 10, 2021, search by [application software, medical interview]).

This study investigated whether a medical interview support application (Ubie; Ubie, Inc. Japan [14]) can help doctors with low clinical experience to list appropriate differential diagnoses. Additionally, using heart rate variability analysis as an indicator of stress levels [15], we investigated whether the use of a medical interview support application would reduce the mental stress among the medical staff.

Methods

Fifteen junior residents (less than two years of post-graduation) conducted medical interviews to determine the differential diagnosis of 20 simulated patients with various diseases. Each junior resident was required to list at most 10 differential diagnoses after the interview. If the disease portrayed by the simulated patient was in the differential diagnosis, it was considered an appropriate medical interview. The number of questions, duration of the medical interview, and stress levels before and after the medical interview were measured in all medical interviews with simulated patients. After the medical interview, the participants reported their impressions of the medical interview support application in a questionnaire survey.

The primary endpoint of this study was to evaluate the change in the percentage of appropriate medical interviews with and without the medical interview support application. The secondary endpoints were the duration of the medical interview, number of questions asked, and changes in stress parameters.

Method for selecting diseases

We divided the patients into two groups based on the final diagnoses of the patients who were transported to our emergency center between April 2015 and March 2020: high-and low-frequency disease groups. The detailed method is described below. Diagnosis Procedure Combination (DPC) data were used to extract patients' disease names [16]. From April 2015 to March 2020, 34379 patients were admitted to the emergency department. After excluding cases that did not lead to a definitive diagnosis, had undergone trauma, and patients with severely impaired consciousness or cardiopulmonary arrest who had difficulty in being medically interviewed, 6659 patients remained with 798 disease names. These diseases were arranged in order of the number of patients seen, and the disease group that could cover about 80% of the patients was defined as the common group (264 diseases), and the remaining 20% of patients were defined as the rare group (534 diseases). About 20 and 22 diseases were nonrandomly

selected from the common (high frequency) and rare (low frequency) groups, respectively, as diseases with high frequency of consultation, diseases with poor prognosis due to delayed diagnosis, and diseases with a high fatality rate (Fig. 1).

Medical interview methods

From each of the selected disease groups (Common and Rare), 10 diseases were randomly selected using a random number table. For the 10 diseases in each of the selected groups, half of the diseases were interviewed with the assistance of the medical interview support application, and the other half were interviewed without using the medical interview support application. The researchers played the role of the simulated patients, and faithfully responded to the medical interview by reviewing the contents of the extracted patients' medical records.

Medical interview support application

The medical interview support application used in this study is a question type flowchart application based on medical dictionaries and research papers. In accordance with the flowchart, relevant questions based on the user's answers are asked repeatedly by the program to present a list of relevant diseases. The questions are selected based on their relevance to the candidate disease. Therefore, as the medical interview proceeds, the results will be narrowed to highly relevant diseases.

Stress assessment methods

The stress experienced by the medical staff during the medical interview was assessed by monitoring the heart rate variability before and after the medical interview. Low-frequency power (LF: frequency range 0.04–0.15 Hz) and high-frequency power (HF: frequency range 0.15–0.4 Hz) obtained from heart rate variability are influenced by sympathetic and parasympathetic nerves, respectively. The LF/HF power ratio reflects the state of the autonomic nervous system and is an indicator of mental stress [15]. By measuring the LF/HF power ratio before and after conducting a medical interview with a simulated patient, we evaluated the stress caused by conducting a medical interview and assessed whether the medical interview support application had a stress-reducing effect.

Statistical analysis

All statistical analyses were performed using the JMP Pro version 14 software (SAS Inc., USA). Mean and median values were compared using Student's t-test and Wilcoxon rank-sum test. The normality and distribution of continuous variables were checked using the Shapiro-Wilk test. Normally distributed data are presented as mean values, and non-normally distributed data are presented as median values. The corresponding two-group test was performed using the Wilcoxon signed-rank test. In all analyses, statistical significance was set at $p < 0.05$.

Results

Primary outcome

The use of a medical interview support application significantly increased the percentage of appropriate medical interviews performed (Fig. 2). Concerning the frequency, using the medical interview support application significantly increased the percentage of appropriate medical interviews in the rare group; however, no difference was observed in the common group.

Secondary outcomes

Figure 3 shows the time required for the medical interviews. The interview duration using the medical interview support application was significantly increased in the user group compared to the non-user group (427 s [362-479s] vs. 239 s [158.7-323s]; $p < 0.0001$). Considering the frequency in the common group, the duration of the medical interview was significantly longer in the group using the medical interview support application than in the non-user group (444 s [387.5–512] vs. 218 s [154–308]; $p < 0.0001$). Similarly, in the rare group, the use of the medical interview support application significantly increased the interview duration (402 s [351–450] vs. 240 s [177–363]; $p < 0.0001$). Figure 4 shows the number of questions asked during the medical interviews. The number of questions in the group that used the medical interview support application was significantly increased compared to the non-user group (37.5 ± 7.2 vs. 13.6 ± 4.8 ; $p < 0.0001$). Considering the frequency in the common group, the number of questions asked during the medical interview was significantly higher compared to the non-user group (39.3 ± 7.3 vs. 13.4 ± 4.7 ; $p < 0.0001$). Similarly, in the rare group, the use of the medical interview support application significantly increased the number of questions (35.6 ± 6.7 vs. 13.7 ± 4.9 ; $p < 0.0001$).

Figure 5 shows the results of the heart rate variability analysis. The use of the medical interview support application had no effect on stress reduction ($p = 0.5064$).

Discussion

In our study, the use of a medical interview support application significantly increased the percentage of appropriate medical interviews. Concerning the usefulness according to frequency, the rare group benefited from the medical interview support application, while the common group did not benefit. The participants who conducted the medical interviews in this study were those who had completed six years of medical education, although they had little clinical experience. Therefore, they may have knowledge of the diseases belonging to the common group, which are frequently observed, and be able to make a differential diagnosis even with a few questions. In the absence of the medical interview support application, the common group had a higher percentage of correct responses to the medical interview, while the rare group had an overall lower percentage and more variability in their correct responses. This variability may be due to individual disparities during the six years of medical education, which requires a certain level of medical knowledge. Additionally, they may have studied highly specialized areas in the early stages of their training as junior residents since they will be working in specialized areas of their interest. Future research should examine these possibilities; however, the use of a medical interview support application was expected to not only increase the rate of correct answers but also reduce the variability of the rate of correct answers.

Concerning the duration of the medical interview, the use of the medical interview support application nearly doubled the length of the medical interview duration. Additionally, the number of questions asked increased more than twice as often. In the common group of this study, there was no effect of using the medical interview support application on the rate of correct answers. In other words, this increase in the medical interview duration and number of questions may be due to the inclusion of unnecessary questions by the use of medical interview support applications, or the simplification of questions based on the experience of physicians when the application was not used. When the medical interview support application was not used, the number of questions asked tended to increase in the rare group, although there was no significant difference (13.4 ± 4.9 vs. 14.0 ± 4.8 ; $p = 0.454$). However, in the medical interview using the medical interview support application, the number of questions asked was significantly lower in the rare group than in the common group (39.1 ± 7.1 vs 35.1 ± 6.3 , $p = 0.0022$). The reason for this is unclear but it may be that the common group had more common complaints and required more questions before a differential diagnosis could be made, or that the common group may have been over-trained in the machine learning process.

Heart rate variability analysis was performed to evaluate the stress experienced by the medical staff; no stress-reducing effect was found after using the medical interview support application. The use of such new applications requires familiarity with the device. Although the participants in this study used various applications on their smartphones on a daily basis, this was the first time they had used the application examined here. It is possible that their unfamiliarity with it may have affected the results.

In the questionnaire after the medical interview, many respondents acknowledged that the use of the medical interview support application reduced the number of missed questions. However, on the other hand, it was also acknowledged that it was difficult to interview patients smoothly because they would not be able to perform interviews based on their own expected diseases. It was indicated that the use of a medical interview support application may cause inexperienced physicians to become dependent on the application. However, it was also considered that the use of an application-based interview may broaden the scope of differentiation and enable physicians to perform interviews for unexpected diseases. Additionally, there may be educational benefits for physicians from the questions being asked about the different types of diseases.

The patient samples used in this study were simulated patients based on medical record data, which is different from the actual patients. Therefore, it does not prove the effectiveness of the medical interview support application used in this study in actual clinical practice but only shows its effectiveness as a possibility. Additionally, the number of medical interviewers and simulated patients was small, which may have caused a selection bias.

Conclusion

Although the medical interview support application will increase the interview time and the number of questions, it may be an effective tool for identifying the appropriate differential diagnosis.

Abbreviations

DPC

Diagnosis Procedure Combination; LF:low frequency; HF:high frequency

Declarations

Ethics approval and consent to participate

All participants provided written informed consent. This study was approved by the Institutional Review Board of the Saga University Hospital (IRB Study No. 2020-07-R-01). All methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding authors upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Not applicable.

Authors' contributions

AM participated in data collection, study design, statistical analysis, interpretation of results, and drafting of the manuscript. TM and YS participated in the study design, statistical analysis, interpretation of results, and drafting of the manuscript. HY, MH, MK, KS, KN, RS, MA, KY, SN, and MK participated in the data collection. All authors were involved in revising the manuscript for important intellectual content and have approved the final version to be published.

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Figures

Figure 1

Methods of preparing a simulated patient Ten diseases were randomly selected from each of the common and rare diseases. Half of them were randomly selected and divided into two groups: one using the medical interview support application and the other not using it.

Figure 2

Comparison of correct answer percentages In comparison for all cases, the group that used the interview support application showed a significantly higher rate of correct answers. When validated by the frequency of diseases, the use of the interview support application increased the rate of correct answers in the rare group.

Figure 3

Duration of the medical interview In all validations, the use of the interview support application increased the medical interview duration.

Figure 4

Number of questions per medical interview In all validations, the number of questions per medical interview was significantly increased by the use of the interview support application.

Figure 5

Change in stress scores by medical interview The use of the interview support application was not effective in reducing stress.