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Effect of multimodal comprehensive communication skills training with video analysis by artificial intelligence for physicians on acute geriatric care: a mixed-methods study

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ABSTRACT

Objectives To quantitatively analyse by artificial intelligence (AI) the communication skills of physicians in an acute care hospital for geriatric care following a multimodal comprehensive care communication skills training programme and to qualitatively explore the educational benefits of this training programme.

Design A convergent mixed-methods study, including an intervention trial with a quasi-experimental design, was conducted to quantitatively analyse the communication skills of physicians. Qualitative data were collected via physicians' responses to an open-ended questionnaire administered after the training.

Setting An acute care hospital.

Participants A total of 23 physicians.

Interventions In a 4-week multimodal comprehensive care communication skills training programme, including video lectures and bedside instruction, from May to October 2021, all the participants examined a simulated patient in the same scenario before and after their training. These examinations were video recorded by an eye-tracking camera and two fixed cameras. Then, the videos were analysed for communication skills by AI.

Main outcome measures The primary outcomes were the physicians' eye contact, verbal expression, physical touch and multimodal communication skills with a simulated patient. The secondary outcomes were the physicians' empathy and burnout scores.

Results The proportion of the duration of the participants' single and multimodal types of communication significantly increased (p<0.001). The mean empathy scores and the personal accomplishment burnout scores also significantly increased after training. We developed a learning cycle model based on the six categories that changed after training from the physicians' perspective: multimodal comprehensive care communication skills training; increasing awareness of and sensitivity to changes to geriatric patients' condition; changes in clinical management; professionalism; team building and personal accomplishments.

Conclusions Our study showed that multimodal comprehensive care communication skills training for physicians increased the proportions of time spent

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study qualitatively analyses physicians' multimodal communication skills using artificial intelligence.
⇒ This mixed-methods study combines the quantitative findings of a quasi-experimental study and qualitative results to demonstrate the educational benefits of a multimodal comprehensive care communication skills training programme.
⇒ Our limitations include the use of a single-centre intervention trial with a quasi-experimental design and the need for further analysis of the impact of the study's training programme on patient outcomes.

performing single and multimodal communication skills by video analysis through AI.

Trial registration number UMIN Clinical Trials Registry (UMIN000044288; https://center6.umin.ac.jp/cgi-open-bin/ctr_e/ctr_view.cgi?recptno=R000050586).

INTRODUCTION

The effective and competent communication of physicians with patients constitutes one of the core dimensions of patient-centred care.[1 2] Previous studies have shown that physician–patient communication is significantly positively correlated with patient adherence and that there are positive relationships between physician–patient communication and patient satisfaction, patient empathy and physical health outcomes.[3–5] Verbal and non-verbal communication skills play an important role in patient–physician encounters.[6] Eye contact and physical touch are commonly used effective tools for non-verbal communication with patients.[7 8]

A rapidly ageing population has been associated with a growth in the number of older people with frailty and complex

comorbidities, including dementia and delirium.[9 10] People with dementia are frequently admitted to acute care hospitals. The management of behavioural and psychological symptoms of dementia or delirium is a key challenge in inpatient dementia care, and typical difficulties include the refusal of care, which can result in poor quality of care delivered to patients and has raised serious barriers to providing geriatric care.[10–12] Because communication difficulties with patients can undermine the whole medical encounter, physicians should pay careful attention to this aspect of their practice.[11] Burnout among physicians who care for geriatric patients is steadily growing.[12 13] Furthermore, the COVID-19 pandemic has increased the burden on physicians in acute care hospitals.[14] Thus, at a time when elderly patients have the greatest need to communicate with their physicians, their cognitive and physical changes make this need the most difficult to accomplish.

To address these challenges regarding communication with elderly patients or patients with dementia, previous studies have shown that multimodal communication skills for healthcare workers are effective in geriatric care because humans use both verbal and non-verbal modes to communicate.[15–17] The French care methodology of Gineste and Marescotti, called Humanitude, has been applied extensively in several settings, including hospitals and nursing homes in Europe (France, Italy, Spain, Portugal, Switzerland, Deutschland and Belgium) and Asia (Singapore, South Korea and Japan) over the last 40 years.[18–20] This methodology is a multimodal, comprehensive communication technique that uses a humanist philosophy that highlights respect for individual liberty, autonomy and dignity. This multimodal comprehensive care methodology therefore comprises a set of particularities that allow us to feel that we are members of the human species and recognise other human beings as members of the same species. The methodology focuses on four elements of communication with patients: face-to-face interaction, verbal communication, touch interaction and assistance with standing up.[18] Multimodal communication means a combination of communication modalities. Specifically, caregivers should always use at least two of the following three modes of communication simultaneously: face-to-face interaction, verbal communication and touch interaction.[18] A previous review article demonstrated that this methodology has positive effects on people with dementia and their caregivers, including healthcare professionals and family caregivers.[20]

Previous studies have assessed the efficacy of communication skills training measured by many scales and psychometric questionnaires for patient–physician communication.[21] Other studies have quantitatively analysed single-modality communication, for example, eye contact or verbal communication, using video recording.[22 23] These studies, mostly based on subjective observations, have serious limitations with regard to offering quantitative data to analyse performance more precisely and recommending a course of action.

Therefore, it is crucial to quantitatively and precisely analyse communication skills among physicians in the context of challenges regarding communication with elderly patients or patients with dementia.

The practice of medicine is changing with the development of artificial intelligence (AI) technology. Coupled with rapid improvements in computer processing, AI-based systems are already improving the accuracy and efficiency of diagnosis and treatment across various specialisations.[24] AI can also support the needs of medicine by analysing vast amounts and various forms of data.[24] To our knowledge, although there is a lack of research to formally and rigorously assess communication skills for physicians, AI is capable of assessing the types of communication and interaction between physicians and patients.

Accordingly, our video analysis via AI was developed to analyse healthcare professionals' multimodal communication, that is, their face-to-face interaction, verbal communication and touch interaction.[19 25] Our system collects the viewpoints of participants using a wearable eye-tracking system during a simulated patient encounter, performs facial landmark detection and deep learning-based analyses to detect eye contact, obtains the total utterances from the data of fixed videos and detect the touch duration by annotation of the fixed videos. This study thus quantitatively analyses the communication skills of physicians for geriatric care following their multimodal comprehensive care communication skills training. We also assessed physicians' empathy by using the Jefferson Scale of Physicians Empathy-Health Professionals Version (JSPE-HP)[26] and evaluated physicians' burnout by using the Maslach Burnout Inventory-Human Service Survey (MBI-HSS), both before and after their training.[27 28]

Specifically, we hypothesised that the multimodal comprehensive care communication skills training programme would promote a positive change in physicians' interactive communication with patients, as well as in physician empathy and burnout levels, and that the programme would offer subjective educational benefits to the geriatric and dementia care that physicians in acute care provide. Therefore, we quantitatively analysed the communication skills of physicians in an acute care hospital after the training using AI, and we qualitatively explored the educational benefits of the training programme.

METHODS
Study design, setting and participants
As part of this convergent mixed-methods study, we concurrently conducted an intervention trial with a quasi-experimental design for the quantitative component and administered open-ended interview questions for the qualitative component; we analysed the results of both components after their completion. The participants were consecutively recruited via an offer at the National Hospital Organization Tokyo Medical Centre (a 740-bed tertiary acute care hospital) in May 2021. There

were 302 physicians in the hospital, including 49 fellows in general internal medicine and 10 attending physicians in general internal medicine. The participants were non-randomly sampled, and our inclusion criteria included physicians who (1) cared for older adults and (2) had no prior experience with multimodal comprehensive care methodology training. A total of 23 participants were recruited. Written informed consent was obtained from all the participants. A 4-week training programme was then held at the National Hospital Organization Tokyo Medical Centre from May to October 2021.

Patient and public involvement

This research was conducted with simulated patient involvement. No patients were invited to comment on the study design, and none were asked to interpret the results. No patients were asked to contribute to the writing or editing of this document.

Intervention

We developed a multimodal comprehensive care methodology training programme for physicians to teach the multimodal communication skills that are used in acute care. The programme includes weekly 1-hour video lectures for 4 weeks that teach the philosophy of the methodology and the basis of the communication skills. Each video lecture was followed by weekly bedside training for participants to use this methodology in the hospital by certified instructors. The training programme was delivered to each physician individually.

Data collection

The participants who consented to the study completed pretraining survey forms in our baseline assessment. The participants provided background information, including their age, gender, years of clinical experience, role as a physician (clinical fellow or attending physician) and specialty. The participants also completed the JSPE-HP to assess their empathy as physicians before the training.[26] In addition, they completed the MBI-HSS to evaluate their level of physician burnout.[27 28] The participants provided pretraining data directly to the researchers on the day of the pretraining survey. On the same day, the participants performed physical examinations on a simulated patient. The hypothetical scenario presented the case of an elderly woman with advanced dementia who was admitted to the acute care hospital because of ischaemic colitis and a pressure injury in her right heel. The patient was bedridden and not able to communicate verbally due to advanced dementia. Participants examined the patient's abdomen and foot in a private patient room. During each physical examination, participants wore Tobii Pro Glasses 2 to collect the first-person video and gaze data of the participants while they performed the physical examinations on the simulated patients. The Tobii Pro Glasses 2 is a wearable eye-tracking system that was calibrated at the start of the study for each participant.[29] The recordings were saved for subsequent analysis and transmitted through a
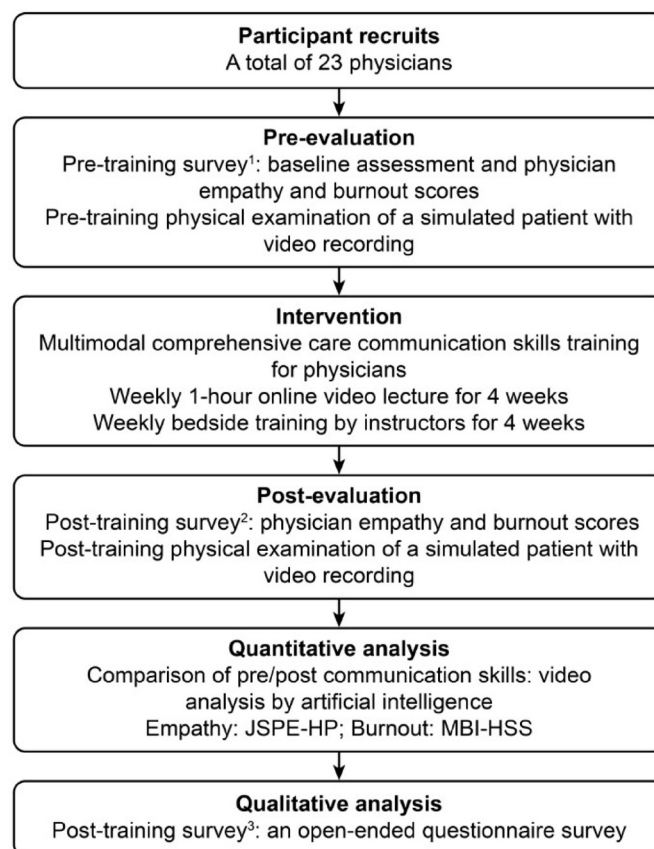
Figure 1 Procedure of the multimodal comprehensive care methodology training programme for physicians in acute care hospitals. [1]Pretraining survey: completion of the baseline assessment that included the physician's age, gender, years of clinical experience, role (clinical fellow or attending physician) and specialty. The participants also completed the Jefferson Scale of Physicians Empathy-Health Professionals Version (JSPE-HP) and the Maslach Burnout Inventory-Human Service Survey (MBI-HSS). [2]Post-training survey: completion of the JSPE-HP and MBI-HSS after 1 month of training. [3]Post-training survey: collected via the physicians' responses to an open-ended questionnaire, administered after their training.

wireless network to a computer for real-time visualisation. In addition, two fixed cameras were used to record the physical examinations. Each video starting from when the physician entered the room to the moment they left the room was analysed. After the pre-evaluation, participants had 4 weeks of the intervention, which was followed by the post-evaluation, comprised of the same survey and physical examinations of the simulated patient. All the participants completed all pretraining and post-training surveys (figure 1).

The study participants completed an open-ended questionnaire survey provided by a researcher (SU), including specialised informatics, after the completion of their training. The survey consisted of the following questions that aimed to examine the effect of communication skills training for physicians: 'Did you feel any changes in the real clinical experiences after the training?', 'Did you feel any changes in yourself after the training?' and 'Did

you see any changes in the difficult situations you had felt during care before the training?'. The participants returned the completed questionnaire surveys directly to the researcher.

Video analysis by AI

We defined the quality of each communication skill as the proportion of time spent in eye contact, touch, verbal expression and multimodal communication during the patient encounter.[30][31] Multimodal communication means that participants use at least two of the following three modes of communication simultaneously: eye contact, verbal expression and touch interaction, which were described in the Introduction section.[18] We aimed to quantise and analyse the communication skills of participants by using wearable sensing and AI technology devices. The performance of the participants was analysed from when they entered the patient's room to the moment they left the room. We used the eye-tracking device (Tobii Pro Glasses 2) worn by the participants to evaluate eye contact. The data collected by the Tobii Pro Glasses 2 worn by the participants included the facial distance, angle and eye-contact states between the participants and the simulated patient by using facial landmark detection by AI. The length of the participants' utterances was detected from the fixed video data. We annotated the videos and obtained the total utterance duration of each session. Touch was annotated using the fixed videos, and the total touch duration of each session was obtained. Finally, the total duration of multimodal communication was confirmed as using at least two of the following three modes of communication simultaneously: eye contact, verbal expression and touch interaction. The normality of all the data for the duration of the communication skills was verified by the Shapiro-Wilk test. A Wilcoxon signed-rank test was also used to test for significant differences between the pretraining and post-training proportions of time spent performing communication skills. Statistical significance was defined when $p<0.05$.

Empathy and burnout outcomes and analyses

The JSPE-HP was specifically developed to measure empathy in health professionals. This questionnaire is a 20-item instrument that has been widely used and validated among health professionals. It uses a 7-point Likert scale that is anchored by 'strongly disagree' and 'strongly agree' (range: 20–140).[32][33] In this study, the Japanese version of the JSPE was used.[34] All the participants completed the JSPE-HP, and the scale was administered before and after their training.

To measure burnout, the MBI-HSS for medical personnel, which is the global standard for healthcare professionals, was used.[35] This validated instrument includes 22 items, each of which is scored from 0 to 6 based on the self-reported frequency of the feeling addressed by each item. In addition to providing an overall measure of burnout, the instrument enables the measurement of the three distinct domains of burnout using summated ratings. The emotional exhaustion domain consists of nine items, with a total score range of 0–54. The depersonalisation domain consists of five items, with a total score range of 0–30. The personal accomplishment domain consists of eight items, with a total score range of 0–48. Specifically, we defined the presence of physician burnout as any score over 26 on the emotional exhaustion subscale, any score over 9 on the depersonalisation subscale or any score under 34 on the personal accomplishment subscale.[36] All the participants completed the MBI-HSS before and after the training.

These analyses were performed using R statistical software (V.4.0.2). The data characteristics of the physicians were analysed using descriptive statistics. Analytical statistics were employed to address the outcomes. The normality of all the data was verified by the Shapiro-Wilk test. The Wilcoxon signed-rank test was also used to test for significant differences between the pretraining and post-training JSPE-HP and MBI-HSS scores. Statistical significance was defined as $p<0.05$.

Qualitative analysis

The textual data of the questionnaire survey were analysed qualitatively by the Steps for Coding and Theorization (SCAT) method,[37][38] which was developed to be an easily accessible qualitative data analysis method involving sequential and thematic qualitative analysis. The SCAT method consists of generative coding and theorisation and is applicable in analyses of open-ended questionnaire responses. Accordingly, the participants' written responses were reviewed by researchers (MKobayashi, MKatayama, MH) with >10 years of clinical experience in general internal medicine in acute care hospitals. These responses were then coded by content while keeping their original opinions intact. Next, these categories were further reviewed and divided into subcategories based on this coding, and each subcategory was given a title. These subcategories were then consolidated into main categories based on their emergent themes, which were also given a title. The three authors worked together to analyse and title these themes and categories. The final step of SCAT entails developing theories that weave together the identified themes and constructs. Following this, the three authors created a diagram to indicate the relationships within the main categories. These analyses were all conducted in Excel V.2019 (Microsoft Corporation, Redmond, Washington, USA).

RESULTS
Quantitative results

A total of 23 physicians were enrolled in the study and completed the multimodal comprehensive care methodology training programme. Among the 23 participants, the post-training response rate was 100% (23 patients). The physicians were an average age of 32 years old (SD=5.1). Fourteen were male (60.9%). Twenty-two of the physicians (95.7%) specialised in general internal

Table 1 Mean proportions of time spent performing communication skills during pretraining and post-training

	N	Pretraining (%)	Post-training (%)	P value*
Eye contact	21	5.7	27.4	**<0.001**
Verbal expression	21	39.6	53.1	**0.006**
Touch	21	37.7	46.1	**0.03**
Multimodal	21	15.5	43.1	**<0.001**

The bold numbers are significant p values (<0.05) before and 3 months after the training.
*Wilcoxon signed-rank test.

medicine. Eighteen of the physicians were clinical fellows (78.3%). The participants had an average of 6 years of clinical experience (SD=4.3).

Comparison of the proportion of time spent in single and multimodal communication during simulated patient care

A total of 23 physicians performed physical examinations on a simulated patient before and after their training. Two participants were excluded due to a recording error. The data on the proportions of time spent performing communication skills during pretraining and post-training are shown in table 1. The proportions of time spent performing multimodal communication skills significantly increased from pretraining to post-training (multimodal: 15.5% to 43.1%, p<0.001). The proportions of time spent performing single communication skills also significantly increased after training (eye contact: 5.7% to 27.4%, p<0.001; verbal expression: 39.6% to 53.1%, p<0.001; touch: 37.7% to 46.1%, p=0.03).

Comparison of JSPE-HP scores and MBI-HSS scores

A total of 23 (100%) patients were assessed. The results of the pretraining and the post-training JSPE and MBI-HSS scores are shown in table 2. The JSPE scores showed a statistically significant improvement (from 111.0 to 119.6, p<0.001) from pretraining to post-training. The number of physicians with burnout decreased after training from 19 to 15. The MBI-HSS scores also showed significant improvements in personal accomplishment (from 28.3 to 30.7, p=0.004). However, there were no significant differences in emotional exhaustion (from 18.9 to 18.7) or depersonalisation (from 6.3 to 6.3) between pretraining and post-training.

Qualitative results

We extracted 14 subordinate concepts and formed 6 final categories of factors that changed after multimodal comprehensive care communication skills training. Table 3 shows illustrative and demonstrative quotes from the physicians' responses to the open-ended questionnaire.

Category 1: multimodal comprehensive care communication skills training for physicians

The participants learnt the importance of using practical multimodal communication skills. They described that they obtained not only a concept of the methodology and knowledge about ageing and dementia, but also practical skills of care based on the philosophy for elderly patients.

Category 2: increasing awareness of and sensitivity to changes in geriatric patients' conditions

Through the training, the participants became increasingly aware of changes in elderly patients' conditions. The participants' awareness increased communication and interaction with patients, which resulted in improved clinical practice skills and the establishment of better patient–physician relationships.

Category 3: changes in clinical management

The participants realised that they underestimated elderly patients' physical and cognitive functions. They reported that the training led them to make proper evaluations of patients, which improved their disposition and decreased not only the number of behavioural and psychological symptoms of patients with dementia but also the overall delirium of geriatric patients.

Table 2 Pretraining and post-training means and SDs of the Jefferson Scale of Physicians Empathy-Health Professionals Version (JSPE-HP) scores and the Maslach Burnout Inventory-Human Service Survey and changes in physician burnout (n=23)

	Pretraining	Post-training	P value*
Mean JSPE-HP score (±SD)	111.0±10.6	119.6±10.5	**<0.001**
Burnout, n (%)	19 (82.6)	15 (65.2)	
Mean emotional exhaustion score (±SD)	18.9±10.0	18.7±11.4	0.89
Mean depersonalisation score (±SD)	6.3±5.3	6.3±5.5	0.88
Mean personal accomplishment score (±SD)	28.3±6.8	30.7±7.8	**0.004**

The bold numbers are significant p values (<0.05) before and 3 months after the training.
*Wilcoxon signed-rank test.

Table 3 Categories and concepts

Category	Physicians' quotes
Category 1. Multimodal comprehensive care communication skills training for physicians	
Overall communication skills	'My way of talking to and touching a patient changed after the training. I started to spend more time observing patients' facial expressions. I also realized the importance of standing up and walking to elderly patients.' (Physician 16) 'I could utilize the skills in my practice, and it worked well.' (Physician 17)
Multimodal communication	'I felt that it became easier to talk with elderly patients because I was able to be closer to them after adopting multimodal communication.' (Physician 19)
Rationale and concept of the methodology	'I could obtain not only a concept of the methodology and knowledge about ageing and dementia, but also practical skills of care based on the philosophy for elderly patients through bedside training.' (Physician 1)
Category 2. Increasing awareness of and sensitivity to changes in geriatric patients' conditions	
Increasing communication and interaction with patients	'I was surprised how a patient's expression and communication dramatically changed after I adopted the methods. I have been able to observe dramatic changes in the communication and expressions of those who had not spoken much before.' (Physician 9)
Improving clinical practice skills towards patients	'I have started to obtain much more information from patients. Physical exams of elderly patients have become smoother, and the methods help me to perform physical exams easier than before.' (Physician 14)
Establishing a patient–physician relationship	'I feel that the barrier between the patient and me has disappeared. I think that the methods are useful for building rapport with patients.' (Physician 23)
Category 3. Changes in clinical management	
Reconsidering the patients' disposition	'I learned that I had been underestimating elderly patients' physical and cognitive functions. This made me reconsider the disposition of the patients and I found that it had actually changed.' (Physician 4)
Understanding the behavioural and psychological symptoms of dementia and delirium	'I have often faced difficulties in caring for patients with dementia or delirium who are hostile to medical staff and refuse all care. I have realized that one of the reasons is that I did not know how to communicate with them properly.' (Physician 12) 'I found that the number of patients with delirium or behavioural and psychological symptoms has decreased through the training.' (Physician 4)
Category 4. Professionalism	
Cure and care	'Learning the methods caused me to respect patients and their lives more.' (Physician 8)
Increasing empathy for patients	'I have been thinking more about the experiences and thoughts of elderly patients whom I had not been able to communicate with well before.' (Physician 21)
Category 5. Team building	
Sharing the concepts and skills with colleagues for team building	'I would like to share the methods with other health care professionals because I think that the methods are useful for anyone who cares for elderly patients, including those with severe dementia and patients with delirium.' (Physician 6)
Medical education	'I started to teach multimodal communication skills to residents and fellows because the skills are useful in acute geriatric care. I hope that the methods can be added to undergraduate and graduate medical education.' (Physician 7)
Category 6. Personal accomplishment	
Internal development	'I am currently much more confident in my practice because of the training, especially the bedside training.' (Physician 5) 'I feel that my fear of interacting with people with deafness and severe dementia has been alleviated. I feel that I have grown as a physician.' (Physician 10)
Continuous learning of the methods	'I would like to continue to learn the methods because I have realized that the methods can improve the outcomes of patients and give me confidence in caring for geriatric patients.' (Physician 15)

Category 4: professionalism

The participants stated the importance of respecting patients and their lives and how their empathy for elderly patients was increased by the training. These observations helped them to develop their professionalism as physicians.

Category 5: team building

The participants reported that they hoped to share the concept and skills for team building with all healthcare professionals. They also suggested that the training programme could be added to undergraduate and graduate medical education curricula.

Category 6: personal accomplishment

The participants noted an improved confidence in relation to geriatric care, enhanced joy as physicians and a reduced fear of geriatric care after their training. These internal developments led them to strongly desire continuous education on the related methods.
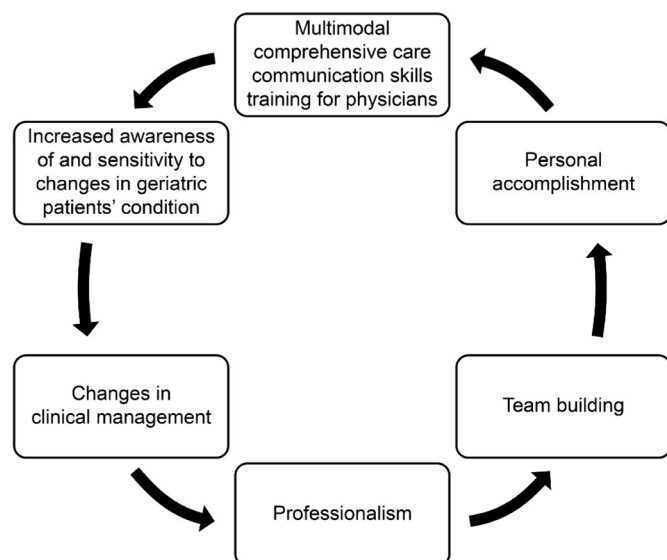
Figure 2 Overview of physicians' changes after the multimodal comprehensive care communication skills training programme.

Relationship between the categories and theorisation

We found that these six categories were closely related to each other. Thus, we theorised their relationship as a learning cycle model (figure 2). We theorised that this training programme increased the physicians' awareness of and sensitivity to changes in patients' conditions, resulting in changes in clinical management. The results lead physicians to develop their professionalism, which drove them to build a team with other healthcare professionals. The training fostered the physicians' internal development, which created a learning cycle through a desire to continue their training.

DISCUSSION

This is a mixed-methods study that includes a quasi-experimental trial to investigate the efficacy of multi-modal comprehensive care communication skills training for physicians in an acute care hospital by video analysis with AI. The findings of this study show that multi-modal comprehensive care communication skills training for physicians increases the proportions of time spent performing both single and multimodal communication skills.

This is the first study to use AI in quantitative communication analysis. Previous studies have quantitatively analysed single-modality communication using video recording in health communication research. However, these studies were based on estimation by an observer to analyse performance.[22 23] To the best of our knowledge, no interventional studies of physicians have evaluated quantitative and objective changes in basic communication skills, such as eye contact, verbal expression or touch. To objectively evaluate physicians' eye contact, the eye-tracking system yields precise measurements.[30] Not every research question about communication skills requires

the precision that eye-tracking enables.[30] However, given that the communication skills training was for physicians who face challenges regarding communicating with patients with dementia or delirium, eye-tracking also enables researchers to evaluate eye contact with more refined criteria, thereby facilitating replication studies. Eye-tracking analysis by AI is now becoming less time-intensive, enabling larger sample sizes.[30] We also annotated the videos and obtained the total utterances and touch duration of each simulated patient encounter. This required considerable time, and there was the risk of obtaining biased results caused by annotator subjectivity. We are currently developing a method for detecting and analysing voice signals and sensing touch behaviours through the use of wearable contact sensors with behavioural video analysis. The physicians' tone, speed, volume and content of their speech and place and pattern of touch will need to be integrated in the future to evaluate the quality of their communication skills for patients. Quantitative analysis of physicians' communication skills using video analysis through AI will likely advance healthcare professional practice.

Our study shows that the proportions of time spent making eye contact, verbal expression, physical touch and multimodal communication by the participating physicians significantly increased after the training. Previous studies have demonstrated that various communication skills training programmes are effective in improving physicians' communication skills, similar to our study results.[39–41] However, the primary and secondary outcomes of these studies were based on a variety of healthcare professionals' outcomes, including scales, health status, perception of the interview, perception of their behavioural change and perception of their attitude change.[39–41] To the best of our knowledge, no interventional studies of physicians have evaluated quantitative changes in basic communication skills, such as eye contact, verbal expression or physical touch. The reason for the increase in physicians' communication skills after this training is likely that its methodology provides a clear conceptual basis for communication skills. In our qualitative analysis, participants reported that they were able to systematically learn multimodal comprehensive care communication skills because the programme's methods included communication skills, dementia-related knowledge and humanist philosophy.

Our findings are similar to the evaluations of two previous communication training interventions that used randomised controlled trials (RCTs) and were shown to be particularly effective in improving communication skills for oncologists and residents.[42 43] These studies are also similar to our study in that their multimodal comprehensive care communication skills training did not decrease physicians' emotional exhaustion in burnout despite increasing their empathy. We suggest that there are two reasons why the training did not decrease emotional exhaustion and depersonalisation in our study. First, although previous studies have largely found

a negative relationship between burnout and empathy among medical staff, a few studies have supported the hypothesis that there is a positive correlation between burnout and empathy.[44] The latter studies have concluded that physicians who demonstrate high levels of empathy suffer from compassion fatigue, which leads to burnout.[44] Second, this study is similar to another previous study in which physicians from a compassionate-empathic group were younger and had fewer years in medical practice but reported more emotional exhaustion compared with other physicians.[45] Thus, we need to acknowledge that younger physicians seem to follow a more idealistic approach and have a compassionate-empathic attitude, which may lead to a risk of burnout. However, we have no data to support these explanations, which are only speculations. On the other hand, there are differences between our study and the two mentioned above[42 43]; specifically, our study indicates that the training reduced burnout and increased personal accomplishment scores. The two prior studies on communication skills training were not supported by bedside instruction.[39 40] In contrast, the training in our present study provided bedside instruction involving actual elderly patients in acute care. Interestingly, although previous studies have shown that physician burnout increased in acute care hospitals during the COVID-19 pandemic, that is, when our study was conducted,[14] we found that physician burnout did not increase during this time. As our qualitative analysis shows, physicians' experiences of dramatic changes in their patients via bedside instruction might lead to an increase in their personal accomplishment scores.

Furthermore, our qualitative study demonstrates that the effect of the training on physicians can be theorised as a learning cycle model in the context of acute geriatric and dementia care. These findings intersect and corroborate the quantitative findings discussed above. Physicians in acute care hospitals have to handle work-related difficulties, such as communicating with elderly patients with dementia or delirium. However, they typically report being insufficiently trained in communication skills for caring for elderly patients during their medical education.[46] Thus, we hypothesised that this stress and lack of self-efficacy to communicate with elderly inpatients can contribute to the development of physician burnout and a reduction in physician empathy. Our qualitative results produced a learning cycle model in which increasing multimodal communication with patients through the training led to enhanced clinical experiences concerning patients' positive physical and cognitive changes, which were followed by changes in clinical management for elderly inpatients. Previous studies have shown that communication skills training of physicians increases patients' satisfaction and reduces their anxiety.[47 48] However, there is a lack of qualitative studies demonstrating an association between communication skills training for healthcare professionals in acute care and the clinical outcomes of elderly inpatients, for example, discharge disposition or delirium symptoms. Although healthcare workers or

medical students may develop many aspects of communication through experience prior to medical school, effective communication in the context of healthcare practice is highly technical and likely requires training, as well as deliberate, targeted practice and feedback, to develop skilled performance.[49–52] Interestingly, all the participants were satisfied with this training and reported that the training was worth the effort as it enhanced their personal accomplishments in their clinical practice. Future quantitative studies are needed to assess the clinical outcomes of geriatric patients through a multimodal comprehensive care communication skills training programme for healthcare professionals in acute care settings.

Limitations

Several limitations of this study should be discussed. First, we used an intervention trial with a quasi-experimental design instead of an RCT. Therefore, it is possible that confounding factors influenced the association between the training, communication skills, and JSPE-HP and MBI-HSS scores. Further randomised controlled studies with larger sample sizes are needed. Second, the sample size of this study was small. Third, our outcome assessment time frame might be a weakness with respect to our assessment of the physicians' communication skills, empathy and burnout. While the empathy and burnout of physicians may be significantly improved immediately after this training, there are limited insights concerning the long-term efficacy of the training. Fourth, the assessment of communication skills in this study was not performed with real patients. Further studies are needed that involve real patients. Fifth, self-report measurements of empathy and burnout in a medical population may be subject to social desirability bias. Thus, it can be difficult to ascertain whether training or awareness of the desirability of an empathetic physician increases empathy.[53] Self-report surveys can be an effective and reliable measure of physician empathy, but they must be validated against patient-report measures. Our last potential limitation is the participant bias of our study results. Our study was conducted at a single hospital in Japan, and many of the participants' specialties were related to general internal medicine. To our knowledge, there is a lack of studies evaluating the culture differences of physicians caring for older adults. Physicians' gender, upbringing, proximity to older adults in their personal lives and religion may play a role in communications with older adults. Future studies that involve a variety of participants with different cultures are needed to overcome these limitations.

CONCLUSIONS

The current study was conducted to quantitatively analyse by AI the communication skills of physicians who care for geriatric patients in an acute care hospital before and after multimodal comprehensive care communication skills training and to qualitatively explore the educational benefits of this training programme. We found that

multimodal comprehensive care methodology training increased the proportions of time spent performing single and multimodal communication skills by video analysis through AI.

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