Use of text messages to communicate clinical recommendations to health workers in rural China: a cluster-randomized trial

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Objective To compare the effectiveness of mobile phone text messaging and that of traditional health worker training in communicating clinical recommendations to health workers in China.

Methods A cluster-randomized controlled trial (Chinese Clinical Trial Register: ChiCTR-TRC-09000488) was conducted in 100 township health centres in north-western China between 17 October and 25 December 2011. Health workers were allocated either to receive 16 text messages with recommendations on the management of viral infections affecting the upper respiratory tract and otitis media (intervention group, n = 490) or to receive the same recommendations through the existing continuing medical education programme – a one-day training workshop (control group, n = 487). Health workers’ knowledge of the recommendations was assessed before and after messaging and traditional training through a multiple choice questionnaire. The percentage change in score in the control group was compared with that in the intervention group. Changes in prescribing practices were also compared.

Findings Health workers’ knowledge of the recommendations increased significantly in the intervention group, both individually (0.17 points; 95% confidence interval, CI: 0.168–0.172) and at the cluster level (0.16 points; 95% CI: 0.157–0.163), but not in the control group. In the intervention group, antibiotic and steroid prescriptions decreased by 5 percentage points but antibiotic prescriptions remained unchanged. In the control group, however, antibiotic and steroid prescriptions increased by 17 and 11 percentage points, respectively.

Conclusion Text messages can be effective for transmitting medical information and changing health workers’ behaviour, particularly in resource-limited settings.

Introduction

Health workers in rural China do not receive systematic, qualified medical education and training1–3 because, unlike their urban counterparts, they face constraints such as inadequacies in transport and funding and they are largely unaware of the need for education.4–6 Gansu Province has 16 853 health workers (including family physicians, nurses, public health practitioners, pharmacists, midwives and laboratory technicians) in 1333 township health centres, distributed across 14 regions.7 Most of the health centres are located in remote mountainous areas, and thus providing continuing medical education to these health workers is a major challenge.8

Mobile text messages have been used to improve health outcomes in a wide range of contexts because of their low cost and convenience.9–11 For instance, text messages have been used in health programmes for smoking cessation,12–14 disease management15–17 and weight reduction18 and to improve adherence to medication17 and attendance at health–care appointments.19 Since Chinese mobile phone users send high volumes of messages – 79 billion messages, equivalent to 73 per user – in September 2012 alone20 – we hypothesized that such messages could be useful for communicating medical information to rural health workers in China.

In general, text messages seem to be effective for communicating information in a health–care context and have been well accepted by users.21–23 Research also indicates that text messages could serve as a powerful tool for behaviour change,19–21 both in developed and developing countries.21 However, so far research has focused almost exclusively on the sending of health messages to patients rather than to health workers, and on the use of messages as patient reminders rather than for the delivery of evidence-based information. In this study, we tested whether text messages sent to rural health workers containing evidence-based recommendations could improve knowledge and influence prescribing medical practice.

Methods

Study design, participants and recruitment

The study was undertaken in the Gansu province in north-western China from 17 October to 25 December 2011. It was designed as a “before” and “after” randomized controlled trial. The intervention group was sent text messages on the management of viral infections affecting the upper respiratory tract and otitis media, and the control group was given the same messages in the context of a regular continuing medical education programme. In preparation for the trial, we undertook several surveys and conducted two pilot studies in seven health centres in Gaolan county, Gansu province, between November 2009 and April 2011. Information on these pilot studies, which were conducted to choose the best content and delivery of the text messages and to conduct a power analysis for the trial, can be obtained from the corresponding author on request.

To be eligible for recruitment individuals had to be health workers in a township health centre in Gansu province. The term “health worker” was used broadly to include family physicians, nurses, public health practitioners, pharmacists, midwives and...
laboratory technicians. Only physicians could prescribe drugs, but other health workers were also sent text messages because of their potential influence on physician behaviour. In addition, the pilot studies showed that confining text messages to physicians made other health workers feel excluded. Health workers who did not own a mobile phone or whose mobile phone could not receive text messages were excluded from the trial.

Sample size

The power calculations were based on the results of two pilot studies and the formula outlined by Donner and Klar for cluster randomized trials with a binary study outcome. The analysis of variance estimator of the intra-cluster correlation coefficient was calculated as 0.15. We initially calculated the minimum sample size to be 76 health centres with a total of 742 participants, allowing for a 40% loss-to-follow-up. However, in light of higher rates of loss to follow-up in the pilot studies, we increased the number of health centres to 100 to improve statistical power.

Randomization

We used the health centre as the unit of randomization. A cluster design was used to avoid biases arising from the possible conveyance of information by members of the intervention group to members of the control group if both were located at the same health centre. Randomization was done in two stages. First, with the help of the health administration department of Gansu province, we sent invitation letters to all 1333 health centres in Gansu province. By the deadline, 163 health centres had agreed to participate in our study. From these centres we randomly selected 100 for inclusion in the trial; we then used a computer-generated random sequence to select the clusters for intervention. To minimize the potential for selection bias, cluster allocation was masked from statisticians until the analyses were completed.

The intervention

For the main trial, we created 18 text messages. Of these messages, 16 contained evidence-based recommendations for the management of the infections affecting the upper respiratory tract and middle ear that are most common in rural Gansu – the common cold, influenza, pharyngitis, tonsillitis – and of otitis media, a frequent complication of upper respiratory infections. The recommendations were mainly sourced from Clinical evidence and the Cochrane Library. Senior physicians from the First Hospital of Lanzhou University revised the language of the recommendations to ensure that health workers in rural areas could understand the messages clearly. All text messages were within 280 Chinese characters in length, the maximum for most mobile phones in China.

The intervention was carried out from 15 November to 24 December 2011. A computer sent the text messages to the intervention group three times a week (on Tuesdays, Thursdays and Saturdays) at 20:30. The control group received the recommendations through the traditional method, a one-day training programme delivered by two senior physicians from the First Hospital of Lanzhou University, held on 3 December 2011.

Data collection

Health workers were interviewed by telephone and asked questions to test their knowledge of disease management – for the five selected acute respiratory conditions – before and after the intervention and the traditional training workshop. The difference between the intervention and control group in the percentage point change in average test score was the main study outcome. A secondary outcome was the difference between the intervention and control group, expressed in percentage points, in the average number of antibiotic and steroid prescriptions issued by family physicians.

Telephone surveys were conducted on 5 and 6 November 2011 (before the intervention) and on 24 and 25 December 2011 (after the intervention) using a computer-assisted telephone interviewing system based on random dialing. Participants were asked 10 multiple-choice questions on the appropriate treatment of the selected diseases and complications. All questions were scored as one point per correct response and zero points for an incorrect response. We assumed that scores reflected health workers’ ability to identify the appropriate action when confronted with a specific medical problem. Scores were averaged as a percentage of questions answered correctly at both the individual and cluster level. An additional questionnaire was administered to record participant satisfaction with both the intervention and the educational methods used in the control group.

To assess family physicians’ prescription practices, random sampling using a computer-generated randomization procedure was used to select 10 health centres in each cluster for the collection of prescriptions. Investigators then collected drug prescriptions for upper respiratory infections in these health centres from 1 December 2011 to 28 February 2012. As a comparator, they also obtained the prescriptions issued over the same period one year before the trial (i.e. from 1 December 2010 to 28 February 2011). Prescriptions for upper respiratory infections were chosen for the trial because: (i) viral infections affecting the upper respiratory tract are very common in rural China, especially during late autumn and winter; (ii) health workers at township health centres often inappropriately prescribe antibiotics and steroids for these viral infections.

Statistical analysis

Analysis was by intention to treat. All statistical analyses were conducted using SAS software, version 9.2 (SAS Institute, Cary, USA). At the cluster level, we calculated the average knowledge score for each cluster (i.e. health centres) and used it as the outcome. An independent t-test was conducted to compare the difference in average scores between the intervention and control groups, with a 95% CI of the average score difference. At the individual level, a linear mixed model (mixed procedure in SAS) was performed to evaluate the intervention effect. The cluster was chosen as a random effect to account for the dependence of individuals within the same cluster. The model contained the study groups (intervention versus control), sex and baseline score as fixed effects. Missing values were entered by the cluster mean input method. Sensitivity analysis was performed by analysing the observed outcomes only. Statistical significance was defined as P < 0.05.

Ethics and consent

The trial was registered with the Chinese Clinical Trial Register on 15 August 2009 (registration number ChiCTR-TRC-09000488) and received approval by the Chinese Ethics Committee of Registering Clinical Trials (ChiECRCT-2012026). Informed consent was obtained via telephone survey and all calls were recorded automatically by the computer-assisted telephone interviewing system.
Results

Of the 1333 health centres invited to participate in the trial, 163 health centres agreed, and of these 100 were chosen at random and allocated either to the intervention group (490 health workers at 52 health centres) or the control group (487 health workers at 48 health centres) (Fig. 1).

The first telephone survey to assess knowledge of the recommendations before the intervention was successfully conducted with 348 people in the intervention group, and 349 in the control group. The second telephone survey to assess knowledge after the intervention was successfully completed with 301 people in the intervention group, and 332 in the control group. An analysis of baseline characteristics showed no statistically significant differences between the two groups (Table 1).

After receiving text messages, the average score in the intervention group increased significantly more than in the control group, both at the cluster and the individual level (Table 2). In subgroup analyses, family physicians’ scores in the intervention group increased significantly more than scores in the control group, both individually and at the cluster level (Table 2).

In the intervention group, no change in the prescription of antibiotics was found; however, prescriptions for steroids fell by 21 percentage points (Table 3). In the control group, prescriptions for antibiotics and steroids increased by 17 and 11 percentage points, respectively.

During the follow-up survey on attitudes towards the text messages containing evidence-based recommendations, one third of the health workers in the intervention group reported that they frequently adopted the recommendations in their clinical decision-making and 95% wanted to continue receiving the text messages (Fig. 2).

Discussion

This study shows that compared with traditional methods of medical education, text messages are more effective in leading to a greater understanding of recommendations, especially for family physicians, a result that was shown by changes in prescribing practices.

Several reasons explain the success of text messages in transmitting medical information. First, for the majority of health workers, text messages were the only way they obtained the latest and best clinical knowledge. In our pilot studies, we found that continuing medical education in Gansu Province consisted primarily of training sessions hosted by higher-level health departments. However, due to constraints in time and resources, such training sessions happen infrequently, and only reach a small number of health workers throughout the province. Thus, 80% of family physicians relied on medical textbooks to guide the diagnosis and treatment of patients, most of which contained outdated and incorrect recommendations.

Second, compared to textbooks and printed learning materials, text messages were easier to carry, retrieve and remember. Moreover, our pilot study showed that, of alternative means of
communicating medical information, such as television, radio, newspapers, or blackboards in health centres, health workers ranked text messages as their preferred method.30

Third, text messages were tailored to the local disease context and edited on the basis of feedback to suit health workers’ clinical needs. The slight difference in the results at the individual and cluster level could be due to minimal texting between health workers in the same health centre. Text messages delivered during the intervention were perhaps the first time that some health workers became aware of

Table 1. Baseline characteristics of health workers in study on the use of text messaging to communicate clinical recommendations to health workers, Gansu province, China, 2011

<table>
<thead>
<tr>
<th>Demographic characteristics</th>
<th>First telephone survey</th>
<th>Second telephone survey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control group</td>
<td>Intervention group</td>
</tr>
<tr>
<td></td>
<td>(n = 349)</td>
<td>(n = 348)</td>
</tr>
<tr>
<td>Mean age, in years (SD)</td>
<td>31.59 (8.30)</td>
<td>31.18 (8.09)</td>
</tr>
<tr>
<td>Mean length of service, in years (SD)</td>
<td>8.15 (9.08)</td>
<td>7.94 (8.64)</td>
</tr>
<tr>
<td>Sex, no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>234 (67.0)</td>
<td>237 (68.1)</td>
</tr>
<tr>
<td>Female</td>
<td>115 (33.0)</td>
<td>111 (31.9)</td>
</tr>
<tr>
<td>Type of health centre, no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>32 (66.7)</td>
<td>32 (61.5)</td>
</tr>
<tr>
<td>Key</td>
<td>16 (33.3)</td>
<td>20 (38.5)</td>
</tr>
<tr>
<td>Health workers, by type of health centre, no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>212 (60.7)</td>
<td>197 (56.6)</td>
</tr>
<tr>
<td>Key</td>
<td>137 (39.3)</td>
<td>151 (43.4)</td>
</tr>
<tr>
<td>Health worker grade,a no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>11 (3.15)</td>
<td>3 (0.9)</td>
</tr>
<tr>
<td>Intermediate</td>
<td>57 (16.33)</td>
<td>45 (12.93)</td>
</tr>
<tr>
<td>Junior</td>
<td>174 (49.86)</td>
<td>199 (57.18)</td>
</tr>
<tr>
<td>Other</td>
<td>63 (18.05)</td>
<td>59 (16.95)</td>
</tr>
<tr>
<td>Unclear</td>
<td>44 (12.61)</td>
<td>42 (12.07)</td>
</tr>
<tr>
<td>Medical training, no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undergraduate</td>
<td>97 (30.0)</td>
<td>87 (25.0)</td>
</tr>
<tr>
<td>Post-secondary education</td>
<td>209 (60.0)</td>
<td>212 (60.9)</td>
</tr>
<tr>
<td>Vocational and technical education</td>
<td>43 (10.0)</td>
<td>49 (14.1)</td>
</tr>
<tr>
<td>Family physicians, no. (%)</td>
<td>204 (58.5)</td>
<td>183 (52.6)</td>
</tr>
<tr>
<td>Other health workers, no. (%)</td>
<td></td>
<td>145 (41.5)</td>
</tr>
</tbody>
</table>

SD: standard deviation.
a This refers to the category of title obtained after passing a qualifying test. “Other” includes non-physicians, primarily public health workers engaged in disease prevention and control and allied health professionals, who are usually medical technicians.

Table 2. Average scores obtained by health workers, at the cluster and individual level, on knowledge of the management of viral infections affecting the upper respiratory tract and middle ear, Gansu province, China, 2011

<table>
<thead>
<tr>
<th>Health worker type</th>
<th>Average scorea, mean (SD)</th>
<th>Differenceb (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First telephone survey</td>
<td>Second telephone survey</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>Intervention group</td>
</tr>
<tr>
<td></td>
<td>(n = 487)</td>
<td>(n = 490)</td>
</tr>
<tr>
<td>Allc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cluster level</td>
<td>0.33 (0.07)</td>
<td>0.32 (0.6)</td>
</tr>
<tr>
<td>Individual level</td>
<td>0.33 (0.13)</td>
<td>0.32 (0.12)</td>
</tr>
<tr>
<td>Family physiciansd</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cluster level</td>
<td>0.35 (0.08)</td>
<td>0.32 (0.9)</td>
</tr>
<tr>
<td>Individual level</td>
<td>0.34 (0.13)</td>
<td>0.33 (0.12)</td>
</tr>
</tbody>
</table>

CI: confidence interval; SD: standard deviation.
a A correct response received 1 point; an incorrect response received 0 points.
b This represents the difference between the intervention and control group in change in average test score between surveys. For example, the difference for all health workers at the cluster level (0.16) was calculated by subtracting the difference in the control group from the difference in the intervention group, as follows (0.47 − 0.32) − (0.32 − 0.33).
c This refers to the category of title obtained after passing a qualifying test. “Other” includes non-physicians, primarily public health workers engaged in disease prevention and control and allied health professionals, who are usually medical technicians.
d Missing values are imputed.
limited opportunities for continued medical education. Yet research has shown that medical education and physicians’ knowledge of the latest recommendations can have a direct influence on the prescription of antibiotics. In our study, text messages may have prevented family physicians from prescribing antibiotics and steroids for viral infections affecting the upper respiratory tract. This is of critical importance, since the use of antibiotics has increased at an average annual rate of around 15% in China from 2000 to 2011, a finding supported by the prescribing practices of the control group in this study.

Health workers reported that the biggest advantage of using text messages was the ease in receiving and retrieving information. Preliminary research found that health workers had limited time to study medical information, with 62% of health workers having less than 3 hours per week to read medical literature. Health workers also reported a preference for information delivery platforms that were more convenient and easier to use. Text messages are limited to only 280 characters, however, which prevent the dissemination of highly detailed recommendations. This weakness could be overcome by increasing the frequency that text messages are sent. An open-access database for health workers that included detailed information on the treatment of each disease could further resolve this issue. Text messages received high scores for their validity and applicability, which suggested that recommendations should be both evidence-based and suited to the local disease context. Nearly all participants in the intervention group (95%) wanted to continue receiving text messages.

A major benefit of using text messages is the cost-effectiveness, which is a key consideration in resource-poor settings. Each text message costs approximately 0.1 Yuan (United States dollars, US$ 0.016) to send. In this study, total expenditure on text messages for the intervention group was less than 1000 Yuan (US$ 160.64), or less than 2 Yuan (US$ 0.32) per health worker. In comparison, the one-day training for the control group cost an average of 560 Yuan (US$ 89.96) per health worker, for printed materials, accommodation and transportation costs. This amounts to a 280-fold difference per person. While not discounting the advantages of traditional medical education, such as the face-to-face interactions, discussions, and communication between trainees and trainers, the use of text messages provides an effective low-
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On the basis of our pilot studies and this cluster-randomized trial, our findings showed that text messages offer a convenient, inexpensive, and effective method to disseminate evidence-based recommendations with the effect of increasing rural health workers’ clinical knowledge and positively impacting their prescription practices.

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Competing interests: None declared.

ASTRACT

The cluster-randomized trial was preceded by pilot studies conducted at seven health centres over the course of two years. These pilot studies assessed the viability and applicability of text messages for continued medical education, and found that using text messages as a knowledge translation tool could change physician knowledge and behaviour.

However, our results should be considered within the limitations of the study. First, although we evaluated the long-term effects (i.e. one year) of the intervention in our pilot study, only the short-term effects (i.e. three months) were evaluated by telephone survey in the main trial. Future studies should address the long-term utility of text messages as a tool of knowledge translation. Second, the causal relationship between text messages and physicians’ behaviour change remains ambiguous, and could not be fully addressed in this study. Third, although health workers’ scores were higher, on average, after the intervention, their scores remained poor. This suggests that text messaging may be an improvement over the traditional educational method but that its role in continuing medical education needs to be researched further. Fourth, the complexities of behaviour change might not have been fully captured by this study. We assumed that prescriptions were reflective of behaviour, and that physicians were important loci of change, given their authoritative role in health centres. Future studies could build on our findings by developing them through behaviour change theories.

METHODS

Aim

The aim of this study was to assess the feasibility of delivering evidence-based recommendations to health workers, and evaluate its potential usefulness and practicality as a knowledge translation tool.

Setting

This study was conducted in selected rural health centres in the northern part of China. The centres covered a large area and had different socioeconomic profiles. The centres were involved in both primary and secondary care and provided a range of services to the local community.

Participants

The participants were health workers employed in the centres. They included doctors, nurses, and auxiliary staff. The study was approved by the Ethics Committee of the First Hospital of Lanzhou University.

Data collection

Data collection involved a questionnaire survey and a telephone interview. The questionnaire included questions about the participants’ demographics, their knowledge of the recommendations, and their willingness to implement them.

Results

The results showed that the text messages were well-received by the health workers. They found the messages useful and informative, and reported that they were able to use the information to improve their practice. The messages were also found to be easy to follow and to be a convenient way to access the information.

Conclusions

The results of this study suggest that text messaging can be an effective tool for delivering evidence-based recommendations to health workers. However, more research is needed to fully evaluate the potential of this approach.

References


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Utilisation du texting pour communiquer les recommandations cliniques aux professionnels de la santé en Chine rurale: un essai randomisé par grappes

Objectif Comparer l’efficacité du texting par téléphone portable et celle de la formation traditionnelle des professionnels de la santé en matière de communication des recommandations cliniques aux professionnels de la santé en Chine.

Méthodes Un essai contrôlé randomisé par grappes (numérotation en registre chinois de l’enregistrement des essais cliniques: ChiCTR-TRC-09000488) a été mené dans 100 centres de santé communaux dans le nord-ouest de la Chine entre le 17 octobre et le 25 décembre 2011. Les professionnels de la santé ont reçu soit 16 messages textuels contenant des recommandations sur la gestion des infections virales affectant les voies respiratoires supérieures et des otites moyennes (groupe d’intervention, n = 490), soit les mêmes recommandations, mais par le biais du programme de formation continue médicale existant – un atelier de formation d’une journée (groupe témoin, n = 487). Les connaissances des professionnels sur ces recommandations ont été évaluées avant et après la réception des messages textuels et la formation traditionnelle par le biais d’un questionnaire à choix multiples.

Résultats Les connaissances des professionnels de la santé sur les recommandations ont augmenté significativement dans le groupe d’intervention, à la fois individuellement (0,17 point; intervalle de confiance de 95%: 0,168–0,172) et au niveau de la grappe (0,16 point; IC de 95%: 0,157–0,163), mais pas dans le groupe témoin. Dans le groupe d’intervention, les prescriptions de stéroïdes ont diminué de 5 points de pourcentage, mais les prescriptions d’antibiotiques sont restées constantes. Dans le groupe témoin cependant, les prescriptions d’antibiotiques et de stéroïdes ont augmenté respectivement de 17 et 11 points de pourcentage.

Conclusion Les messages textuels peuvent être efficaces pour transmettre des informations médicales et changer le comportement des professionnels de la santé, en particulier dans les endroits où les ressources sont limitées.
Sanitario recibiría bien 16 mensajes de texto con recomendaciones sobre el tratamiento de las infecciones víricas que afectan a las vías respiratorias superiores y otitis media (grupo de intervención, n = 490) o bien las mismas recomendaciones a través del programa de educación médica continua existente - un taller de capacitación de un día de duración (grupo de control, n = 487). Los conocimientos del personal sanitario se evaluaron antes y después del envío de los mensajes de texto y de la formación tradicional por medio de un cuestionario de respuestas múltiples. Se comparó el porcentaje de cambio en la puntuación del conocimiento sobre la formación tradicional por medio de un cuestionario de respuestas múltiples. Se comparó el porcentaje de cambio en la puntuación del conocimiento sobre la formación tradicional y se evaluaron antes y después del envío de los mensajes de texto y de la formación tradicional.

Conclusión Los mensajes de texto pueden ser eficaces para transmitir información médica y cambiar el comportamiento del personal sanitario, especialmente en entornos con recursos limitados.

Resultados El conocimiento del personal sanitario acerca de las recomendaciones aumentó significativamente en el grupo de intervención, tanto a nivel individual (0,17 puntos, IC del 95%: 0,168–0,172) como a nivel del grupo (0,16 puntos, intervalo de confianza del 95%: 0,157–0,163), pero no en el grupo de control. En el grupo de intervención, las prescripciones de esteroides disminuyeron en 5 puntos porcentuales, aunque las de antibióticos no presentaron cambios. En el grupo de control, sin embargo, aumentaron las prescripciones de esteroides y de antibióticos en, respectivamente, 17 y 11 puntos porcentuales.

References