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Effectiveness of an educational intervention in improving healthcare workers' knowledge of early recognition, diagnosis and management of rheumatic fever and rheumatic heart disease in rural far-western Nepal: a pre/post-intervention study

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ABSTRACT

Objectives Rheumatic fever (RF) and rheumatic heart disease (RHD) remain among the major heart problems among children in Nepal. Although these conditions are preventable and treatable, the lack of proper knowledge and resources to diagnose and manage these conditions in rural health centres is a key concern. This study assessed the impact of educational sessions to improve the knowledge of healthcare workers in the early recognition, diagnosis, and management of RF and RHD in rural far-western Nepal.

Design, setting and participants This study used a pretest and post-test interventional design and was conducted among 64 healthcare workers in two primary healthcare centres and a peripheral district-level hospital in Achham district in the far-western region of Nepal. A self-administered questionnaire was used before and after the educational sessions. Data were analysed using SPSS V.21.

Results The overall test scores increased from 10 (SD=2.4) pre-intervention to 13.8 (SD=1.9) post-intervention (p<0.001). Similarly, participant confidence (graded 1–5) in differentiating bacterial from viral sore throat rose from 3.6 (SD=1.08) pre-intervention to 3.98 (SD=1.09) post-intervention (p<0.05). Confidence in managing RF increased from 3.9 (SD=0.88) pre-intervention to 4.30 (SD=0.8) post-intervention (p<0.001).

Conclusion The findings suggest that the investigated educational sessions are promising with respect to improving the knowledge and confidence of healthcare workers in the early recognition, diagnosis, and management of RF and RHD at the primary healthcare level. Further studies with a larger sample size and conducted in different parts of the country are warranted to assess the effectiveness and impact of scaling up such educational interventions in Nepal.

INTRODUCTION

Rheumatic heart disease (RHD) is a chronic heart condition caused as a sequel to rheumatic

Strengths and limitations of this study

► A novel study assessing the impact of an educational intervention to improve knowledge of health workers in the early recognition, diagnosis and management of rheumatic fever and rheumatic heart disease in Nepal.

► Representation of rural Nepal and similar settings.

► May not be representative of all healthcare workers working in rural areas of Nepal as some participants had regular continuing medical education sessions, whereas some did not.

► A control group was not included in the study, which might have biased our interpretation of the results as some improvement in knowledge might have occurred just by being in a rheumatic heart disease research environment.

► Assessing the sustained effect of educational sessions by conducting a late post-test was outside the scope of this study.

fever (RF), which most often begins in childhood as a group A β-haemolytic streptococcal (GAS) throat infection.[1] Although RHD is a preventable and treatable form of cardiovascular disease, it accounts for 33.4 million cases with 10.5 million disability-adjusted life-years and 0.3 million deaths globally.[2] RHD is a common problem in developing countries, including Nepal, with prevalence reported to be 0.9–1.35 per 1000 school-going children.[3] However, globalisation and migratory flows have contributed to the resurgence of RF worldwide.[4 5] In the Nepalese population of 27 million, the incidence of RF is estimated to be 15 000 per year and the incidence of RHD

is 7500 per year.[6] As RHD is attributable to poverty and social inequality, most cases of RHD are concentrated in economically disadvantaged rural communities.[7] Though primary prevention of RF and RHD is ideal for reducing the mortality due to RHD, it is still challenging for countries like Nepal, where underlying risk factors such as overcrowding, poor hygiene and limited access to healthcare are still prevalent.[8]

In Nepal, the paramedical staff are usually the first contact points for a rural population with RF/RHD. Hence, these primary health workers should be equipped with the knowledge and skill to prevent RF/RHD. However, they have limited training and experience in diagnosing and treating RF/RHD cases leading to underdiagnosis of the disease.[9] The government of Nepal and the Nepal Heart Foundation (NHF) have taken some initiatives for delivering disease-specific healthcare while developing the national programme for control of RF and RHD.[9] NHF has achieved success in developing an RF/RHD registry, training paramedics, publishing recommendations and guidelines, securing a supply of benzathine penicillin G (BPG), and working on improving the quality and safety of BPG supplies and piloting primary prophylaxis.[9] However, there is no evidence that those programmes have penetrated the rural population of far-western Nepal. Lack of knowledge and skills to diagnose patients with RF/RHD among the primary healthcare workers is a loss of opportunity to prevent the disease and its progression. Globally, it is evident that interventions such as lectures and training can significantly increase the knowledge and skills of healthcare workers in the prevention and treatment of RHD, which otherwise remains low.[10 11] The WHO has also stressed the importance of conducting education and training programmes for all health workers involved in the primary or secondary prevention of RF/RHD.[12] So, our research aimed to study the effectiveness of an educational intervention in improving the knowledge of healthcare workers working in healthcare facilities in rural settings about the early recognition, diagnosis and management of RF and RHD in a far-western district of Nepal.

METHODS
Study setting
The study sites were primary healthcare facilities of Achham district, a rural hilly district in the far-western province of Nepal. Two primary healthcare centres (PHCCs): Chaurmandu PHCC and Kamalbazar PHCC, and one district-level hospital (Bayalpata Hospital) were selected conveniently.

Study population and sampling
The study population included healthcare workers working in the primary healthcare settings in Achham district of Nepal. The participants were chosen conveniently and included health assistants (HAs), staff nurses, auxiliary nurse midwives, auxiliary health workers (AHW)

and medical officers. Altogether, 64 healthcare workers were enrolled in the study. Of note, the participants of Bayalpata Hospital regularly attended Continuing Medical Education (CME) sessions on various topics throughout the year. However, the participants from other sites did not attend such sessions.

Intervention design
This study involved a pretest followed by an educational session, and a post-test conducted with 6–12 study participants per session. A total of seven sessions, one each in Kamalbazar and Chaurmandu PHCCs and five sessions in Bayalpata Hospital, were conducted. The educational session was an hour-long interactive session facilitated by a trained medical doctor using a conventional Power-Point presentation. The presentation topics included: (1) introduction to RF and RHD; (2) pathophysiology of RF and RHD; (3) clinical features and diagnostic criteria; (4) prevention and treatment; and (5) follow-up for RHD treatment and care. The details on each topic area were presented during the educational sessions. The educational intervention included practical information relevant to rural healthcare settings. The sessions aimed to enable healthcare workers in terms of available healthcare resources to identify symptoms related to RF/RHD so that they could initiate appropriate treatment for RF and RHD and if needed they could refer the patients to a nearby tertiary care health centre. The training material also contained information to help healthcare workers to use appropriate antibiotics for treating bacterial sore throat and to facilitate ongoing secondary prophylaxis of RHD. We used the same set of questions for pretest and post-test which assessed the knowledge of clinical presentation, diagnosis, treatment, and primary and secondary prevention of RF and RHD.

Study tools
The study tools included pretest and post-test questionnaires and a PowerPoint presentation. Prior to the development of these tools, a range of relevant tools, guidelines, and other published literature were searched and reviewed. After reviewing the literature, a draft questionnaire and a PowerPoint presentation were collaboratively prepared by the authors which were then reviewed by the study team members, subject experts, researchers and policymakers in order to ensure content validity. While developing the tools, greater emphasis was given to the information that was deemed relevant to healthcare workers in rural areas. For the questionnaire, we selected practical and frequently encountered questions based on our collective experiences working on RF/RHD in rural areas. The questionnaire was pretested among 10 healthcare workers in a PHCC in a rural setting of Lalitpur district, Nepal. This district is different from the one where the main study was conducted. Necessary edits and amendments, such as simplifying the language, adding the Nepali translation of the questionnaire, adding a few more questions (such as the prevalence of RF and

RHD, the purpose of long-term antibiotic prophylaxis of RF), were done in the final version. A total of 18 objective questions for assessing knowledge and 2 Likert scale-based questions for assessing confidence were included in the questionnaire. Both the pretest and the post-test questionnaires had the same questions.

Sample size and power
For sample size estimation, a previous study[11] was considered where the knowledge of 87 participants regarding prevention of RF/RHD, on an average, increased from about 54% before the lecture to about 92% after the lecture. Using this effect size and assuming no correlation between the pre-lecture and post-lecture observations, a sample size of 26 was obtained from a sample size calculator[13] with a power of 80% for a two-tailed test with 95% significance. To allow for differences in study settings (tertiary vs primary level care) and study participants (specialists vs mid-level healthcare workers), the target sample size was doubled to 52. More participants were invited than our target sample size. The power of this study was estimated to be greater than 80% at a 95% significance level.

Study variables
There were two types of variables in this study. One was the frequency counts (categorical variable) of discordant pairs of correct and incorrect answers for each question in a 2×2 McNemar's table. The other variable was the participants' score (continuous variable, overall score and the scores for two Likert scale-based responses). The variable range for the overall score was 0–18 and the range for the Likert-based questions was 1–5. Our primary endpoint was a change in the participants' overall score (out of 18) before and after the educational intervention.

Data analysis
Data analysis was done on SPSS V.21. The descriptive analysis was performed using mean and SD for continuous variables and percentages for categorical variables. The objective questions had one mark each for correct response (a total of 18 marks). The Likert-based questions were graded 1–5 for strongly disagree, disagree, neutral, agree and strongly agree, respectively. Knowledge scores were calculated for every participant and the mean knowledge score was calculated both before and after the educational session. The McNemar test was employed to test the differences in marginal frequencies of categorical variables between pretest and post-test. Paired t-test was used to evaluate pre–post changes in knowledge scores (for continuous data). For all statistical analyses, a p value of less than 0.05 was considered statistically significant and all tests were two tailed.

Patient and public involvement
Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this study.

Table 1 Health centres and total participants

Health centres	Participants (n)	Per cent
Bayalpata Hospital	41	64
Kamalbazar PHCC	15	23.5
Chaurmandu PHCC	8	12.5

PHCC, primary healthcare centre.

RESULTS
General characteristics of the participants
A total of 64 healthcare workers from 3 health facilities (Bayalpata Hospital, Kamalbazar PHCC and Chaurmandu PHCC) were included in the study as shown in table 1.

The mean age of the participants was 27±6.7 years. Among the participants, 50% were men and 50% were women. The mean working experience of the participants was 5.83±4.6 years. As shown in table 2, the majority of the participants (36%) were AHWs, followed by HAs (29.7%) and staff nurses (18.7%).

The participants' responses were tabulated under four main domains: screening related, diagnosis related, management related and miscellaneous, as shown in table 3.

Table 4 summarises the change in overall knowledge and confidence of the participants before and after the teaching session. As shown in figure 1, the overall mean knowledge score improved from about 10 (out of 18) in the pretest to about 13.8 in the post-test, an improvement of 38% (p<0.001). When asked about the most likely cause of murmur in a hypothetical situation of a 16-year-old man with shortness of breath on exertion, most of the health workers correctly identified RHD (94% vs 86% on pretest and post-test, respectively) from the options given (congenital heart disease, RHD, iron deficiency anaemia and endocarditis). Eighty-one per cent of the participants knew that the most common age of getting RF and RHD is 5–15 years. After the session, all the participants knew

Table 2 Characteristics of participants

Characteristics	Number	Per cent
Sex		
Male	32	50
Female	32	50
Age		
Mean (SD) years	27 (6.7)	
Working experience		
Mean (SD) years	5.83 (4.6)	
Designation		
Medical officer	1	1.6
Staff nurse	12	18.7
Health assistant	19	29.7
Auxiliary health worker	23	36
Auxiliary nurse midwife	9	14

Table 3 Participants' responses

SN	Questions	Number of participants who gave the correct answers (N=64)		P value
		Pretest	Post-test	
Screening related				
1	Most common cause of murmur in adolescents	60 (94%)	55 (86%)	0.13
2	Most common age for RF	52 (81%)	64 (100%)	0.001
3	Most common presentation of RF	50 (78%)	58 (91%)	0.04
4	Most likely cause of a sore throat	16 (25%)	16 (25%)	0.83
5	Not a feature of bacterial sore throat	43 (67%)	62 (97%)	<0.001
6	Prevalence of RF/RHD	26 (41%)	55 (86%)	<0.001
Diagnosis related				
7	Natural history of RF	30 (47%)	51 (80%)	<0.001
8	Confirmatory test for RF	7 (11%)	5 (8%)	0.69
9	Patient with RF with dancing movement	44 (69%)	60 (94%)	<0.001
10	Complication of RF	8 (13%)	33 (52%)	<0.001
Management related				
11	Prevention of RF/RHD	58 (91%)	61 (95%)	0.51
12	Preferred antibiotic to treat GAS	22 (34%)	49 (77%)	<0.001
13	Preferred antibiotic for prophylaxis of RF	49 (77%)	51 (80%)	0.75
14	Prophylaxis against RF prevents progression of	17 (27%)	40 (63%)	<0.001
15	Serious adverse effect of penicillin	39 (61%)	57 (89%)	<0.001
16	Drug of choice in penicillin-allergic patients	44 (69%)	56 (88%)	0.01
17	Prevention of anaphylaxis due to BPG	54 (84%)	62 (97%)	0.04
Miscellaneous				
18	Aetiopathological nature of RF	20 (31%)	47 (73%)	<0.001
19	Confidence in differentiating bacterial from viral sore throat clinically	41 (64%)	59 (92%)	
20	Confidence in recognising, evaluating and managing a case of RF/RHD	43 (67%)	60 (94%)	

Significant at p<0.05.
BPG, benzathine penicillin G; GAS, Group A *Streptococcus*; RF, rheumatic fever; RHD, rheumatic heart disease.

about it. Fever and joint pain were correctly marked as the most common presentation of RF by the majority of the participants, both during the pretest (78%) and post-test (91%). About 41% of the study participants correctly specified that the prevalence of RF/RHD is more common in low-income countries whereas, after the teaching session, this proportion increased to 86%.

The proportion of the health personnel who knew that RHD is a sequela of RF and many, but not all, develop RHD after RF increased from 47% to 80% post-session. While less than half of the study participants incorrectly selected antistreptolysin O (ASO) titre as the confirmatory test for RF before the teaching session, this proportion increased to 72% post-session. Only about 11%

Table 4 Changes in overall knowledge and confidence in managing RF and RHD using paired t-test

Variables	Pretest mean (SD)	Post-test mean (SD)	P value
Overall knowledge	9.98 (2.4)	13.78 (1.9)	<0.001
Confidence in identifying sore throat aetiology	3.66 (1.08)	3.98 (1.09)	0.01
Confidence in recognising, evaluating and managing RF	3.91 (0.88)	4.30 (0.84)	<0.001

Significant at p<0.05.
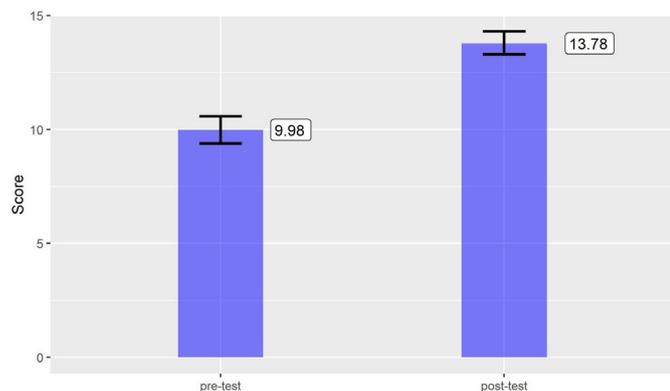RF, rheumatic fever; RHD, rheumatic heart disease.

Figure 1 Mean knowledge score (total=18) with 95% CI.

pre-session and 8% post-session correctly identified that none of the given options were the confirmatory test for RF. While 13% correctly identified cardiac valve damage as a feared complication of RF, this proportion increased to 52% post-session.

About 90% of the participants correctly reported that early recognition and management of streptococcal sore throat could prevent RF and RHD, which increased by 5% after the teaching session. Almost half of the participants answered that the preferred antibiotic for treating GAS was amoxicillin. However, after the teaching session, more than three-quarters of them correctly identified that BPG is, instead, the preferred choice. About 61% of the participants were aware that anaphylaxis is the serious adverse effect of penicillin. The proportion increased to 89% after the teaching session.

About 69% of the participants correctly answered that the drug of choice for RF prophylaxis in penicillin-allergic patients is erythromycin; whereas, after the session, the percentage rose to 88%. Around 64% of the participants were confident in differentiating bacterial from viral sore throat clinically pre-session, which increased to 92% post-session. Similarly, while 67% of the healthcare workers were confident in recognising, evaluating and managing a case of RF before the teaching session, this proportion increased to 94% after the teaching session.

DISCUSSION

The findings of this study indicate that primary healthcare professionals had an average level of understanding of the early recognition, diagnosis, and management of RF and RHD, which improved significantly after an education intervention. The results create an opportunity to continue refining approaches to health education interventions for primary health workers, in order to ensure their increased knowledge and confidence in the early management of RF/RHD cases.

Screening of RF

The health workers had good knowledge of the common age for getting RF/RHD and its most common presentation as fever and joint pain. However, even after the

teaching session, most of the healthcare workers believed that the most likely cause of sore throat is a bacterial infection, instead of viral. The fact that the teaching session emphasised differentiating bacterial from the viral sore throat rather than specifically on the most common cause of sore throat could explain this result. We need to emphasise that sore throat is mostly caused by viruses and that learning to differentiate between a viral and a bacterial sore throat is very important to minimising the misuse of antibiotics. Similar findings were shown by a study done in Tanzania.[14] Before the session, most of the health professionals were unaware that RF/RHD is mostly prevalent in low-income countries. By the end of the session, more than 85% of them knew that most people suffering from RF/RHD live in low-income countries, which is a fact stated by the WHO.[15]

Diagnosis of RF/RHD

The majority of the participants incorrectly identified ASO titre as the confirmatory test for RF. Ironically, this proportion increased after the teaching session. As we know, RF is a clinical diagnosis based on Jones' criteria and there is no single test to diagnose RF. Positive GAS culture and rising ASO titre serve as evidence of recent GAS infection, which is an essential criterion in the Jones' criteria[16] but is not diagnostic of RF per se. It is actually a difficult question and to answer this correctly, one needs to have a good understanding of RF. The short duration of the teaching session was sufficient to provide a brief introduction to ASO titre but insufficient to adequately convey its role in the diagnosis of RF. So, there might have been a response bias leading to more participants selecting the option containing 'ASO titre'.

Management of RF/RHD

The knowledge on preferred antibiotics for treating GAS improved significantly after the session. A single dose of BPG is preferred to oral penicillin or amoxicillin (which has to be given for 10 days) to ensure compliance. Moreover, different studies have shown that intramuscular penicillin reduced RF recurrence and streptococcal throat infections compared with oral penicillin.[17] The participants' awareness about the second drug of choice when there is hypersensitivity to benzathine penicillin was good and increased substantially after the sessions. Based on our pretest questionnaires, we found that about 60% of the health professionals knew that anaphylaxis is a serious adverse effect of penicillin. By the end of the session, the percentage rose significantly to 90%, hence suggesting the effectiveness and need for similar teaching sessions. Similar findings were shown by a study conducted in Malawi.[18] However, the increase in knowledge about the risk of severe adverse effects may discourage clinicians with less experience of providing a very effective medicine. To address this, we emphasised in our teaching session that anaphylaxis is rare and that the benefits far outweigh the risks.[19] We also

included ways to safely administer benzathine penicillin injection and management of anaphylaxis in our teaching session.

In this study, the mean knowledge score of the healthcare workers significantly improved from 10 to 13.8 post-session. Our findings suggested that an educational intervention on RF/RHD can increase the knowledge of healthcare workers, corroborating the findings of a study done in a similar lower middle-income setting.[11] Similarly, teaching sessions like this are found to boost the confidence of health service workers in differentiating bacterial and viral sore throats,[20] and in proper diagnosis, evaluation, and management of RF cases.[18 21] The findings of this study have implications for policy, practice and further research and support the evidence that educational interventions have a significant effect on raising knowledge among healthcare workers in early recognition, diagnosis and management of RF and RHD in primary healthcare settings. Conducting educational interventions with teaching modules focusing on these components is imperative to curb the RF/RHD prevalence in a developing country like Nepal.[22]

Our study had certain limitations. It was conducted in primary healthcare settings of far-western Nepal, hence, it may not be generalisable to the whole country. Also, the participants from Bayalpata Hospital have regular CME sessions on various health-related topics, which is not common in other healthcare facilities, and so, they may not be representative of all healthcare workers working in rural areas. Similarly, knowledge gain may or may not translate into practice as a change in practice has not been evaluated in this study. Further studies that assess the change in the practice of healthcare workers in RF/RHD management after receiving an educational intervention are recommended. Another limitation of this study was that there was no control group in the study; some of the participants might have self-learnt about RF/RHD after they knew that an RHD research was going on. This might have biased our results. Moreover, a late post-test was not performed, thus, we could not ascertain how much of this gained knowledge is retained in the long run.

CONCLUSIONS

We conclude that the educational intervention implemented among the healthcare workers in the far-western part of Nepal improved their overall knowledge in terms of early recognition, diagnosis and management of RF and RHD. These findings are promising to introduce, institutionalise and strengthen the continuous professional development programmes for healthcare workers, especially focused on RF and RHD prevention and control at the primary care level. Further studies with a larger sample size and conducted in different parts of the country are warranted to assess the effectiveness and impact of scaling up such educational interventions in Nepal.

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