

Knowledge, Attitude, and Practices on Drug-Resistant Tuberculosis Infection Control in Nepal: a cross-sectional study

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Abstract

Background

Healthcare centers are important sites for tuberculosis transmission, particularly in low-income settings where the burden of tuberculosis is high and infection control practices are often inadequate. This study aims to assess the knowledge, attitude, and practices of drug-resistant tuberculosis (DR TB) infection control among the healthcare workers under the National Tuberculosis Program in Nepal.

Methods

In this cross-sectional study, we studied the healthcare workers from all the 11 functioning drug-resistant tuberculosis treatment centers across Nepal in March 2018. Trained data collectors conducted face-to-face interviews with a pre-tested questionnaire to collect data on the basic characteristics of healthcare workers, their self-reported knowledge, attitude, and practice on tuberculosis infection control. We entered the data in Microsoft Excel and analyzed in R statistical software. We assigned a score of one to the correct response and zero to the incorrect or no response and calculated a composite score in each of the knowledge, attitude, and practice domains. We ascertained the healthcare workers as having good knowledge, appropriate attitude, and optimal practices when the composite score was at least 50%. We summarized the numerical variables with median and interquartile range (IQR) and the categorical variables with proportions. We ran appropriate correlation tests to identify relationships between knowledge, attitude, and practice scores. We regarded a p-value of < 0.05 as significant.

Results

A total of 95 out of 102 healthcare workers from 11 drug-resistant tuberculosis treatment centers participated in the study. There were 46 male and 49 female respondents. The median age was 33 years (IQR 26-42). Most of them (53, 56%) were mid-level paramedics. The median work experience in drug-resistant tuberculosis was 2 years (IQR 1-5). We found 91 (96%) respondents had a good knowledge of tuberculosis infection control, 49 (52%) respondents had an appropriate attitude and 35 (37%) respondents had optimal practices. We found a statistically significant positive correlation between attitude and practice scores ($\rho = 0.37, p = < 0.001$).

Conclusion

The healthcare workers at the DR TB treatment facilities in Nepal have high knowledge of TB infection control but it did not translate into the appropriate attitude or optimal practices.

Background

Drug-resistant tuberculosis (DR TB), a form of tuberculosis (TB) resistant to one or more anti-tubercular drugs, has emerged as a major public health challenge. Globally, in 2018 alone, there were an estimated 484000 new cases of TB that were resistant to Rifampicin (RR TB), and 78% of these cases also had

resistance to Isoniazid (Multi-Drug Resistant TB [MDR TB]). Furthermore, 6.2% of the MDR TB cases were resistant to additional two important anti-tubercular drugs – a Fluoroquinolone and a second line injectable anti-tubercular agent (Extensively Drug-Resistant Tuberculosis [XDR TB]). More than 90% of these cases are from 30 countries that belong to low or middle-income settings.[1] In Nepal, of the 1400 estimated cases, there were 635 cases of MDR TB notified to the National TB Control Program in 2018.[2]

Until recently, the provision of effective first-line treatment was hoped to prevent the emergence of DR TB. However, growing evidence suggests that person-to-person transmission, not just inadequate treatment, is driving the spread of DR TB. A dynamic transmission modeling analysis using national tuberculosis notification data estimated that person-to-person transmission rather than de novo acquisition accounts for a median 95.9% of all incident MDR tuberculosis and 61.3% of incident MDR tuberculosis in previously treated individuals.[3] In a prospective study of 404 patients with XDR TB in South Africa, investigators combined genotyping methods with social-network and epidemiologic analysis and found that at least 69% of the cases of XDR TB were attributable to transmission.[4] In another study on 324 patients with MDR TB in China, investigators combined traditional genotyping, whole-genome sequencing, and epidemiological investigation and found that transmission of MDR strains accounted for 73% cases of MDR TB.[5]

Healthcare centers represent one of the important sites where DR TB transmission occurs, particularly in settings where the infection control measures are often poor, and the burden of TB is high. In a retrospective study among 148 patients with XDR TB in rural South Africa, investigators found that 113 patients had been hospitalized at least once before being diagnosed with XDR TB and 80 patients had been exposed to the patients with infectious XDR TB during their hospital stay.[6] A study from Moldova, another high MDR-TB burden country, evaluated 67 patients with MDR TB being treated as in-patients and followed them up. It was found that 50 patients (74.6%) had a strain in the follow-up that was different from that of the baseline suggesting a high proportion of MDR TB possibly transmitted during in-patient treatment.[7]

Standard guidelines on TB infection control could help minimize healthcare-based DR TB transmissions and should form an indispensable part of DR TB care. Optimal utilization and implementation of such guidelines could be facilitated by the information on the knowledge gaps, attitudes, and practices on TB infection control of the healthcare workers. However, in many resource-limited settings, TB infection control measures are absent or sub-optimal. In Nepal, dedicated national policy and resources for TB infection control are lacking and a few studies have assessed healthcare workers' knowledge, attitudes, and practices on TB infection control. A study among 190 healthcare workers from 28 TB treatment facilities in Nepal found that the overall knowledge and practices of healthcare workers on TB infection control were not satisfactory.[8] This study, however, was limited to only the urban centers, and the knowledge, attitudes, and practices questionnaire did not extend to include the issues specific to DR TB. Such information could help in the tailored implementation of the guidelines and thus, more effective take-up of the recommendations. In this study, we aimed to assess the knowledge, attitude, and practices

of DR TB infection control among the healthcare workers under the National Tuberculosis Program in Nepal.

Methods

Study settings and participants

We conducted this cross-sectional study among the healthcare workers at the DR TB treatment centers in Nepal in March 2018. DR TB treatment in Nepal is ambulatory care provided through DR TB treatment centers under the National TB Program. Depending upon the volume of patients and their geographic distributions, the NTP identifies different health centers across the country to introduce the DR TB treatment services. After orientation training of the healthcare workers on DR TB care and the provision of required logistics, these centers then start functioning as the DR TB treatment centers and evaluate the presumptive cases of DR TB in close collaboration with the national TB reference laboratories, provide the DR TB treatment to the diagnosed patients, and monitor them as per the national guidelines. All the patients diagnosed with DR TB are enrolled at one of these centers. There were 18 DR TB treatment centers across the country during the data collection period, of which we included 11 centers that had patients enrolled and were receiving treatment. There were 102 healthcare workers involved in the care of the patients with DR TB at these 11 centers and we included all of them in our study.

Data collection

In a one-day training session, we trained six paramedics on the details of selecting study participants, the process of obtaining informed consent, and data collection using the structured data collection tool. Because no standardized data collection instrument is available to evaluate the knowledge, attitude, and practice in the patients with DR TB, we developed a tool based on the earlier studies (Additional file 1: Data collection tool).[9, 10] We pre-tested the tool for any problems in understanding or interpreting the questionnaire and incorporated the feedback in the final version. The pre-testing was done in 10 healthcare workers at the TB clinic of the National TB Center who did not form the part of the actual study sample in the data collection process. The data collection tool consisted of four parts - the first part collected information on the study participants' demographic and other characteristics related to the delivery of DR TB services (current position at work, work experience in general and specific to DR TB care, training received on TB infection control and whether the study participants had encountered colleagues with TB or DR TB). The mid-level paramedics referred to the health workers working as community health workers or health assistants which required vocational education at upper secondary or post-secondary, non-tertiary levels. However, their actual educational qualification, as entered separately in the variable – education, may be of higher level. We classified the education level according to the International Standard Classification of Education.[11] The second part contained a questionnaire on the knowledge which collected information on the study participants' knowledge on the risk of getting infected with DR TB and the administrative, environmental and personal protective measures of TB infection control. The responses were recorded as true, false, and don't know. The third part contained a

questionnaire on attitude which collected information on the study participants' attitude towards DR TB and measures of TB infection control. The responses were recorded as agree, disagree, and no comments. The fourth part contained questions on the study participants' self-reported practices on infection control measures while coming in contact with the patients with DR TB. The responses were recorded as yes, no and don't know.

Data analysis

We entered the data in Microsoft Excel (Office 365, Microsoft Corporation, Washington, United States) and analyzed in R statistical software (R Core Team [2020]. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>). We summarized the numerical variables with median and interquartile range (IQR) and the categorical variables with proportions. We assigned a score of one to the correct response and zero to the incorrect or no response and calculated a composite score in each of the knowledge, attitude, and practice domains. We ascertained the healthcare workers as having good knowledge, appropriate attitude, and optimal practices when the composite score in each of the domains was at least 50%. We ran appropriate correlation tests to identify relationships between knowledge, attitude, and practice scores. A p value of < 0.05 was considered significant.

Results

Of the 102 healthcare workers from 11 DR TB treatment centers, 95 participated in the study (response rate – 93.1%). Altogether, there were 14 missing values across five variables. We assumed that the missing values were missing completely at random and analyzed the remaining data with complete case analysis. The median age was 33 (IQR 26-42) years and there were 49 (51.58%) female respondents. Most of them were mid-level paramedics (53, 55.96%) and had received post-secondary non-tertiary vocational education (44, 46.32%) (Table 1).

Table 1 Demographic characteristics of study participants

Characteristics	Frequency (n)	Percentage (%)
Age groups		
16 - 30 years	42	44.21
31 - 45 years	39	41.05
46 - 60 years	14	14.74
Sex		
Female	49	51.58
Male	46	48.42
Education		
Post-secondary, non-tertiary, vocational education	44	46.32
Bachelors	28	29.47
Upper Secondary Vocational	13	13.68
Masters	10	10.53
Position		
Mid-Level Paramedic	53	55.79
Laboratory personnel	17	17.89
Nurse	13	13.68
Program manager	6	6.32
Doctor	3	3.16
Radiographer	3	3.16
Health Facility Type		
Government	55	57.89
Non-Government	40	42.11
Work experience as a healthcare worker		
1 - 10 years	50	53.76
11 - 20 years	26	27.96
21 - 30 years	13	13.98
31 - 40 years	4	4.30

Work experience in drug-resistant tuberculosis

5 years or less	64	73.56
6 - 10 years	11	12.64
11 - 20 years	12	13.79

The median work experience was 10 (IQR 3 – 18) years and that in DR TB was 2 (IQR 1 – 6) years. The number of study participants providing health services to the patients in addition to the patients with DR TB was 88 (92.63%). Seventy-five (78.95%) study participants reported to have encountered colleagues with TB and 38 participants (40%) reported to have encountered colleagues with DR TB. The majority (71, 74.74%) of the study participants reported that they had received training on DR TB infection control.

The median knowledge score of the study participants was 14 (IQR 12-14) and 91 (96%) participants were found to have good knowledge of DR TB infection control (Figures 1 and 2).

The median attitude score of the study participants was 5 (IQR 4-6) and 49 (52%) participants were found to have an appropriate attitude on DR TB infection control. The median practice score of the study participants was 5 (IQR 4-7) and 35 (37%) participants were found to have optimal practices of DR TB infection control. The responses from the study participants on the knowledge, attitude, and practice questions are provided in tables 2 through 4. All the three variables – knowledge, attitude and practice scores were not normally distributed and therefore, we ran Spearman's rank correlations. We found a positive correlation between attitude score and practice score which was statistically significant ($\rho = 0.37$, $p = < 0.001$) but not between knowledge and attitude scores ($\rho = -0.09$, $p = 0.38$) and knowledge and practice scores ($\rho = -0.18$, $p = 0.079$).

Table 2 Knowledge questions on drug-resistant tuberculosis infection control and the responses from the study participants

Knowledge Questions	True		False		Do not know		Total responses	
	n	%	n	%	n	%	n	%
Drug-resistant tuberculosis is an infectious disease.	85	91%	-	-	8	9%	93	
Drug-resistant tuberculosis is more infectious than drug-sensitive tuberculosis.	76	80%	10	11%	9	9%	95	
Healthcare workers have a higher risk of acquiring tuberculosis than the general population.	89	94%	5	5%	1	1%	95	
The risk of tuberculosis to healthcare workers can be minimized by observing appropriate infection control measures.	83	87%	5	5%	7	7%	95	
Healthcare facilities should implement an infection control program.	88	94%	5	5%	1	1%	94	
Administrative measures are the most effective tuberculosis infection control measures.	57	60%	28	29%	10	11%	95	
The actively coughing patients should be identified and prompt care should be provided to minimize the time spent at healthcare facilities.	87	92%	-	-	8	8%	95	
The actively coughing patients should be encouraged to cover their mouth and nose while coughing or sneezing.	87	92%	-	-	8	8%	95	
Patients with tuberculosis and their close contacts should be educated on the measures of tuberculosis infection prevention.	86	91%	1	1%	8	8%	95	
The waiting area and sputum collection area should be in open and well ventilated space.	85	89%	10	11%	-	-	95	
The health facility should be renovated in such a way that patient consultation rooms and laboratory are well ventilated.	84	88%	3	3%	8	8%	95	
Use of mechanical ventilation and ultraviolet gamma irradiation in health facilities helps to minimize tuberculosis transmission.	86	91%	-	-	9	9%	95	

Surgical masks are as good as N95 masks in preventing tuberculosis transmission.	22	23%	70	74%	3	3%	95
Healthcare workers should wear N95 masks.	92	97%	3	3%	-	-	95
Patients should wear surgical masks.	64	67%	29	31%	2	2%	95
Healthcare workers should be screened for tuberculosis periodically.	89	94%	4	4%	2	2%	95

Table 3 Attitude questions on drug-resistant tuberculosis infection control and the responses from the study participants

Attitude Questions	Agree		Disagree		No comments		Total responses	
	n	%	n	%	n	%	n	%
I am worried that I may contract drug-resistant tuberculosis.	18	19%	28	29%	49	52%	95	
Drug-resistant tuberculosis cannot be cured.	32	34%	60	63%	3	3%	95	
My workplace is concerned about the risk of drug-resistant tuberculosis transmission to its staff.	45	47%	40	42%	10	11%	95	
My workplace has provisioned adequate resources to minimize the risk of drug-resistant tuberculosis transmission to its staff.	32	34%	59	62%	4	4%	95	
I have been well trained in tuberculosis infection control.	50	53%	36	38%	9	9%	95	
Healthcare workers have already been infected with tuberculosis, so taking infection control measures will not help.	37	39%	57	60%	1	1%	95	
The administrative measures of tuberculosis infection control minimize the exposure to tubercular bacilli.	46	48%	45	47%	4	4%	95	
The environmental measures of tuberculosis infection control minimize the number of tubercular bacilli in the environment.	42	45%	44	47%	8	9%	94	
The healthcare workers taking care of the patients with drug-resistant tuberculosis must wear N95 masks.	39	41%	56	59%	-	-	95	
I would like to be tested for tuberculosis periodically.	56	59%	39	41%	-	-	95	

Table 4 Practice questions on drug-resistant tuberculosis infection control and the responses from the study participants

Practice Questions	Yes	No	Do not know	Total responses			
	n	%	n	%	n	%	
My workplace has a tuberculosis infection control committee.	36	38%	37	39%	22	23%	95
There is a tuberculosis infection control focal person ascertained in my workplace.	42	44%	32	34%	21	22%	95
There is a tuberculosis infection control program implemented in my workplace.	59	62%	26	27%	10	11%	95
Adequate resources have been allocated for tuberculosis infection control in my workplace.	50	53%	38	40%	7	7%	95
The healthcare workers have been tested for latent tuberculosis infection.	31	33%	50	53%	14	15%	95
The actively coughing patients are identified and provided prompt care so as to minimize the time spent in my workplace.	61	64%	31	33%	3	3%	95
A separate and open area has been designated as a sputum collection area in my workplace.	55	58%	35	37%	5	5%	95
There are signs of cough etiquette displayed in my workplace.	37	39%	56	59%	2	2%	95
The patient consultation rooms and laboratory in my workplace are well ventilated.	52	55%	41	43%	2	2%	95
There is exhaust ventilation available in my workplace.	-	-	87	92%	8	8%	95
There is ultraviolet irradiation available in my workplace.	-	-	91	96%	4	4%	95
I use an N95 mask most of the time.	22	23%	73	77%	-	-	95
I encourage patients to use surgical masks.	85	89%	10	11%	-	-	95

Discussion

This study aimed to assess the knowledge, attitude, and practices of DR TB infection control among the healthcare workers under the National Tuberculosis Program in Nepal. This is the first study in Nepal assessing the knowledge, attitude, and practices of healthcare workers at DR TB treatment facilities on

TB infection control in a national sample. We found 96% of the study participants had a good knowledge of infection control related to DR TB. However, the knowledge score did not correlate with the attitude or practice scores. Only 52% of the healthcare workers studied had an appropriate attitude and 37% had optimal practices on DR TB infection control. Attitude score significantly correlated with practice score ($\rho = 0.37, p = < 0.001$).

The NTP in Nepal gradually expands its DR TB treatment services across the country based on the number of patients reported, their geographic distributions, and available resources. Before introducing the DR TB treatment services in any health facility, the NTP conducts a five-day-long orientation training on DR TB care to all the healthcare workers involved. This orientation training also contains a session on infection control and is the only formal TB infection control training session available within the NTP in Nepal. Periodically thereafter, these healthcare workers also receive a three-day-long refresher training as a part of continuing professional development. Most (71, 74.7%) of the study participants reported that they had received training on TB infection control. The median work experience in DR TB care was 2 years, implying that most of the study participants had received the training quite recently. These training sessions might have led to a high proportion of healthcare workers having good knowledge of TB infection control. In addition, the background educational qualification of the study participants could have also contributed to the higher knowledge of TB infection control.

Earlier studies have reported different knowledge scores and have found that being trained in TB infection control and a higher level of educational qualification were associated with knowledge in TB infection control. In a national survey of DR TB facilities in South Africa, the average number of correct responses on knowledge questions was 3.1, and a higher level of clinical training and attending a facility-specific infection control training was associated with significantly higher knowledge scores.[1] Though not conducted on the healthcare workers working exclusively on DR TB facilities, a study from Nepal has also reported a significant association of education level and training on TB with the respondents having a good knowledge of TB infection control.[2] These findings underscore the importance of training the healthcare workers in TB infection control, including engaging the healthcare workers in short-term refresher training and encouraging continuous learning. Our finding that 40% of the study participants failed to appreciate administrative control as the crucial measure of TB infection control suggests a need to emphasize this issue in the subsequent training sessions.

Despite the high overall knowledge, more than half of our study participants (53%) (Table 3) felt that they had not been well trained in TB infection control and one-third study participants (34%) felt that DR TB cannot be cured. Fewer healthcare workers had an appropriate attitude or optimal practices on TB infection control putting them at a high risk of acquiring TB or DR TB themselves. A substantial proportion of healthcare workers have encountered colleagues with TB or DR TB suggesting that there are, in fact, significant ongoing TB transmissions among the healthcare workers. Having a higher attitude score, not the knowledge score, was associated with higher scores on TB infection control practices. These findings suggest that the existing TB infection control training by the NTP and the way these sessions have been delivered have failed to influence the attitude and practices among the study

participants. Perhaps, this is, in part, because the existing training sessions are focused on the clinical management of the patients with DR TB, and issues on TB infection control are poorly highlighted. The need for training session specific for TB infection control was also recognized by the earlier study from Nepal.[2] In addition, the study has found that the healthcare worker's attitude level was significantly associated with their level of knowledge on TB infection control allowing to put efforts on increasing the training sessions. However, the findings of this study highlight the need to design the TB infection control training sessions targeting to develop an appropriate attitude so that they bring about sustained behavioral changes. The responses obtained on the practice questionnaire reveal that many of the poor practices could be attributed to the lack of dedicated TB infection control policy and the necessary resources at the DR TB treatment centers. Because most of the healthcare workers at the DR TB centers (92.63%) also provide services to the patients in addition to the patients with DR TB, it is imperative that the NTP prioritize and effectively implement the TB infection control in these centers.

Our study has some limitations. The questionnaire used in this study has not been assessed for reliability and validity thus limiting the scope of the inferences and conclusions made based on the responses obtained. The TB infection control practices recorded in the study are the ones reported by the study participants and not observed by the data collectors or the investigators and therefore, could differ from the actual practices.

Conclusion

This study has shown that the healthcare workers at the DR TB treatment facilities in Nepal have high knowledge of TB infection control. However, it did not translate into the appropriate attitude or optimal practices on TB infection control suggesting the need to prioritize and implement a TB infection control policy in the DR TB treatment facilities and re-design the TB infection control training for healthcare workers that could bring about positive changes in their attitude and practices.

Abbreviations

DR TB Drug-resistant tuberculosis

IQR Interquartile Range

MDR TB Multi-Drug Resistant Tuberculosis

NTP National Tuberculosis Program

RR TB Rifampicin Resistant Tuberculosis

TB Tuberculosis

XDR TB Extensively Drug-Resistant Tuberculosis

Declarations

Ethics approval and consent to participate

We obtained the ethical approval for the study from Nepal Health Research Council (registration number 109/2018, approval reference number 2328/2018). The trained data collectors obtained written informed consent from the participants for participation in the study.

Consent for publication

The consent for participation also included the consent for publication of the findings.

Availability of data and materials

The datasets generated and analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

SKS designed the study, analyzed and interpreted the data, and wrote the manuscript. RBB, LRJ, NA, SKS2, RB, and KNKC contributed to data acquisition. All authors read and approved the final manuscript.

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Not applicable

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Figures

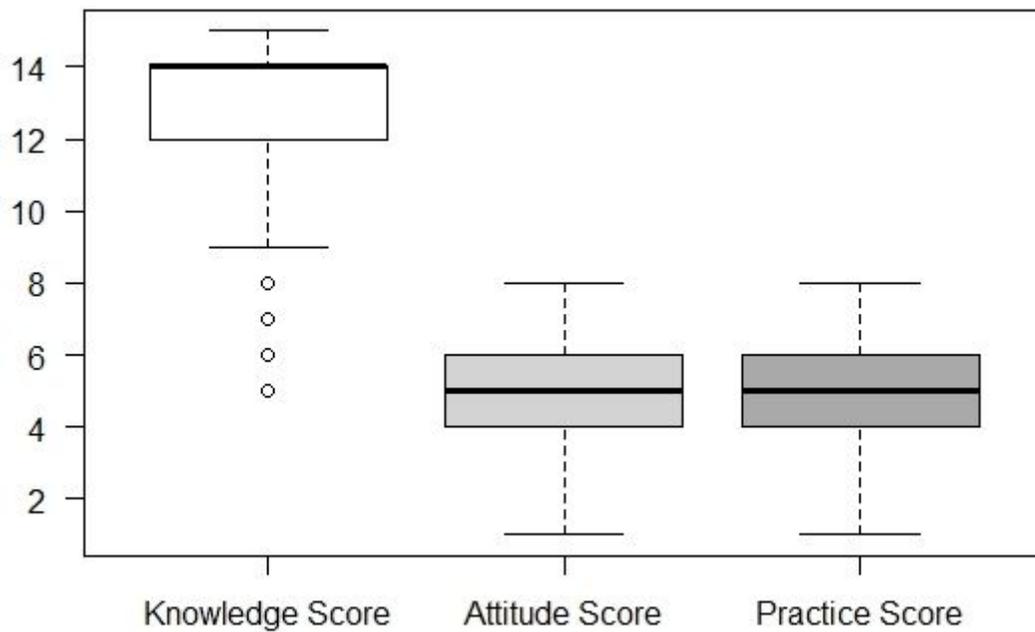


Figure 1

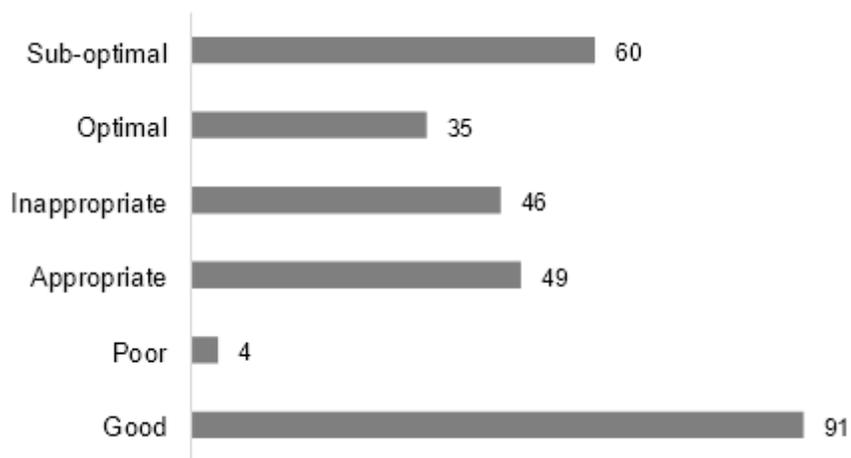


Figure 2

Number of study participants with knowledge, attitude and practice levels

Supplementary Files

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