Research Title: Effectiveness Of Multimodal Hand Hygiene Interventions On Improving Hand Hygiene Practice Of Health-care Workers In A Rural County Of Southwestern China And The Factors Affecting Their Hand Hygiene Practice.

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Background

Hand hygiene (HH) is effective in preventing health-care associated infection. The World Health Organisation (WHO) multimodal HH strategy had been implemented in many countries, and proven successful. However, there was a large research gap in Southwestern rural China. The study was carried out in a rural county, Yongping in Yunnan (Yongping, Da'li Bai Ethnic Minorities Autonomous Prefecture, Yunnan Province). It is a setting with very limited resources, as Yunnan is one of the most impoverished Provinces in China. The study was the first one conducted in Southwestern China, and one of the few ones conducted in rural China implementing the WHO multimodal HH improvement strategy. It was one of the very few studies assessing HH knowledge, attitude and behaviour of health care workers (HCWs) in Southwestern rural China. It was conducted in all four public health care facilities in the rural county Yongping, serving as a useful reflection of HCWs' HH practice in Southwestern rural China. It was the first study to use interviews and focus groups to investigate the factors affecting HH practice in China context, which gave insights on the effect of Chinese culture on HCWs' HH attitude and behaviour. In total, there are 4 public health care facilities in Yongping, including Yongping People's Hospital (PH), Maternal and Child Health Hospital (MCHH), Traditional Chinese Medicine Hospital (TCM), Centre for Disease Control and Prevention (CDC).

Objectives

To evaluate knowledge, attitude and behaviour of HH among HCWs in all public health care facilities in Yongping.
Factors affecting HCWs' HH practice.
To evaluate effectiveness of multimodal HH interventions with respect to WHO multimodal HH improvement strategy.

Methodology

Quantitative

The study was conducted in all four public health care facilities in Yongping. "Hand Hygiene Knowledge Questionnaire for Health-Care Workers" by WHO was translated into Simplified Chinese and validated by Shandong University. It assessed HCWs' knowledge on HH. At baseline before the implementation of the multimodal strategies, questionnaires were distributed to HCWs there, to assess any knowledge gaps among Yongping HCWs on HH. (Calculated sample size: 233. 95% confidence level, margin of error 5%. Sample size: 429). Besides, immediately post-intervention, HCWs in MCHH were asked to fill out the questionnaires again. (Calculated sample size: 34. 95% confidence level, margin of error 5%. Sample size: 34). The post-intervention questionnaire served as an objective tool to assess the effectiveness of the HCWs' education session intervention. Results were analysed with the Statistical Package for the Social Sciences SPSS Version 24.

"Ward Infrastructure Survey" by WHO was used to collect baseline data on existing HH infrastructure and resources, assessing any deficiencies at all four health care facilities. This would enable implementation of potential system changes. It could also be useful in explaining HHC rates.

Observation using "Observation Form" by WHO was used to collect data to measure HHC of HCWs. Objective observations were done during health service to patients. Each observation lasted for 10-20 minutes. Frequency, timing and steps of HH were noted using the Observation Form. When an indication of HH arose at the 5 moments for HH, it was counted as an opportunity. The number of HH actions performed by HCWs at the opportunities indicated the frequency of HH. Compliance= Actions/ Opportunities x100%. Observers were overt. At baseline, observations were done at PH and MCHH, compliance was calculated. Immediately post-intervention, observations were done at MCHH and compliance was calculated.

Qualitative

Besides, during observation, characteristics of HH practice of HCWs were noted qualitatively by observers, aiming to find out any potential factors affecting their HH practice.

At baseline, interviews of HCWs in all health care facilities were first carried out to assess HCWs' attitude on HH, as well as to confirm our results on observation of HCWs' HH behaviour. We could then identify any interventions needed to change HCWs' attitude. Interviews were held privately, one-on-one, to allow HCWs to voice out their real attitude towards HH, and truly reflect HCWs' HH behaviour. Participants were recruited by convenient sampling. A self-designed set of questions were asked during interviews. The questions were generated based on the preliminary data collected from "Hand Hygiene Knowledge Questionnaire for Health-Care Workers", "Ward Infrastructure Survey" and "Observation Form". Then, interviews were carried out with hospital managers in charge of infection control. Besides being used to assess their attitude towards HH and confirm our results of observation, interviews with managers also served as a feedback of HH situation, and as a negotiation of HH interventions. Each interview was tape-recorded, transcribed verbatim and translated. Common themes mentioned more than once were noted.

Later, focus groups were carried out in PH, further exploring HCWs' attitude towards HH. In particular, the focus groups aimed to find out reasons for their non-compliance and find out solutions to tackle the problem. Focus groups were held in 3 cohorts with doctors and nurses from PH. Participants were recruited by convenient sampling. The first cohort comprised 2 doctors and 4 nurses, with the department head doctor and vice head nurse being present. The second cohort comprised 2 doctors and 4 nurses, with no involvement of leaders. The third cohort comprised 6 nurses, with no involvement of leaders. Each group was lead by a moderator who facilitated the discussion and an assistant who marked down the key points of discussion. Besides, non-verbal communication cues, group interaction and dynamics were noted. The moderators had consensus on their roles before the start of the group. They were equipped with the skills to lead focus groups, including asking open-ended and follow-up questions, rephrasing questions, clarifying points with participants. Before the start of discussions, aims of the sessions were made clear. Each participant were encouraged to contribute their genuine thoughts and to respond to other participants constructively. A self-designed focus group guide consisting of a list of pre-determined questions was used to ensure consistency in questions and prompts in cohorts. The questions were designed based on literature review of published papers, as well as qualitative data collected from previous interviews and observations. Each group lasted for around 30 minutes. Each focus group discussion was tape-recorded, transcribed verbatim and translated. Subsequently, thematic analysis was done for data analysis.

Interventions

In MCHH, multimodal interventions were designed based on WHO "Multimodal Hand Hygiene Improvement Strategy". Main strategies included: Establishing baseline, procurement of alcohol hand rub, HCWs education session, displaying workplace reminders and posters, distributing leaflets to HCWs, designing e-learning material, patient education with distribution of brochures, gaining managers' support by influencing their beliefs.

Multimodal interventions based on WHO "Multimodal Hand Hygiene Improvement Strategy" were carried out in PH as well. Main strategies included: establishing baseline; feedback and evaluation activities; gaining managers' support by influencing their beliefs. Improvement solutions were suggested to them.

Interventions in PH were slightly different from that in MCHH. Main strategies in PH did not include procurement of alcohol hand rub, HCWs education session, displaying workplace reminders and posters, distributing leaflets to HCWs, designing e-learning material, patient education with distribution of brochures. However, as an additional intervention, improvement solutions were suggested to PH. This was because in PH, we faced resistance from the Infection Control Department (ICD). Besides, education session was not needed as they had it on a regular basis; Procurement of alcohol based hand rub was not needed as they already had it.

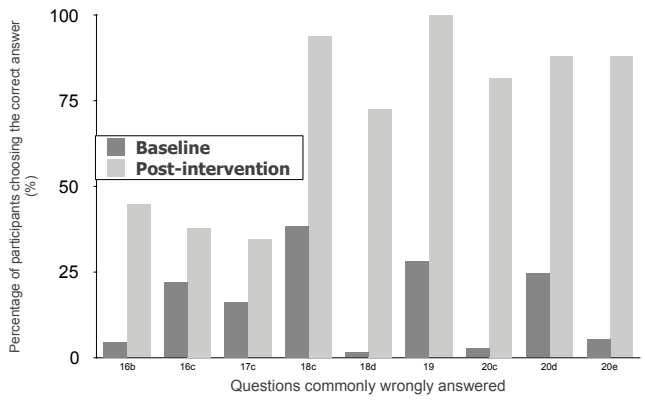
Results

Quantitative

- Knowledge: "Hand Hygiene Knowledge Questionnaire for Health-Care Workers"

Many HCWs did not realise the rationale behind performing a HH action, whether the action would prevent transmission of germs to the HCW or the patient. They failed to identify the correct HH method used at different moments of patient care. Particularly, they did not know that hand washing and hand rubbing should not be performed in sequence. They also failed to recognise the advantages of hand rubbing compared to hand washing. Besides, there were inadequacies in basic HH knowledge, such as the minimal time needed for alcohol-based hand rub to kill most germs on hands, actions associated with a likelihood of colonisation of hand with harmful germs. A knowledge gap on HH existed among HCWs in all public health care facilities in Yongping, which needed to be addressed. Figure 1 shows that after implementation of multimodal strategies, knowledge of HCWs on HH improved. Participating HCWs choosing the correct answer increased significantly for questions that were previously wrongly answered. Multimodal HH improvement strategies, in particular education session was effective in improving HCWs' knowledge on HH.

Figure 1. Baseline and post-intervention questionnaire results in MCHH.



- Behaviour: "Observation Form"

Table 1 shows results of calculated HHC rate using "Observation Form" by WHO. For PH, The calculated HHC rate at baseline was 31.9%, which was higher than their usual maximum of 28% reported by the ICD.
For MCHH, no valid HH actions were performed at baseline. At 1 opportunity, a HCW performed hand rub with her gloves on, without 7 steps, which was an invalid action. Immediately post-intervention, 8 HCWs were observed. 5 of them did not perform HH at all. All of the HCWs who performed HH used hand rub. However, none of them complied with the 7 steps suggested by WHO.
The overall post-intervention HHC rate was 32.7%. Even though improvement was shown compared to 21.4% at baseline, HHC was still lower than the worldwide median rate 40%, showing that further improvement on HHC was needed.
Only MCHH was studied quantitatively for post-intervention. This was because at baseline, MCHH had the poorest HH knowledge, behaviour, attitude among HCWs, and the largest inadequacy in HH infrastructure. Besides, MCHH was the health care facility in which resistance from managers were the least, allowing interventions to be completed smoothly.

Table 1. HHC rate at baseline and post-intervention

	No. of HH opportunities	No. of HH actions	Calculated HHC rate
PH at baseline	69	22	31.9%
MCHH at baseline	34	0	0%
MCHH immediately post-intervention	55	18	32.7%
Overall at baseline	69+34=103	22+0=22	21.4%
Overall immediately post-intervention	55	18	32.7%

- Infrastructure: "Ward Infrastructure Survey"

Yongping health care facilities had inadequate HH infrastructures. Types of taps in hospitals were rather primitive. Most sinks in the health care facilities were only hand-operated. Sinks with clean water, soap and towel were very rarely available. Alcohol based hand rub were rarely available at MCHH and TCM. Functional dispensers were not available at each point of care. HCWs did not have access to hand rub pocket bottles. Posters and reminders on HH technique and indications were incomplete. Inadequate HH infrastructure and resources in wards potentially contributed to the low HHC rate in Yongping health care facilities.

Qualitative

- Secondary data: Adoption of old standards by the Chinese government

From official documents of hospitals and China's "Evaluation criteria for Secondary General Hospitals", China's HH standard was different from that suggested by WHO. In China, 6 steps hand washing for at least 15 seconds was suggested, which was the old HH standard of WHO, different from the current WHO suggestion- 7 steps for at least 20s.

- Behaviour: Qualitative Observation

- Use of CCTV to monitor HHC in neonatal ward

During observation of HH in PH, it was noted that the compliance in neonatal ward was especially high. The reason behind was hypothesised: HCWs knew that CCTV was present in the neonatal ward. Even though there were blind spots that the CCTV could not catch, it had a warning effect on HCWs.

- Hawthorne effect

Higher compliance was noted when the observers wore white coat and introduced themselves with their aims to the observed HCWs before the start of observations. Besides, in MCHH post-intervention, a Pediatrics doctor noticed the presence of the observer. She performed 11 HH actions at all 11 opportunities (HHC rate=100%). As it was a common practice for HCWs to ward round in groups, the doctor clapped her hands to hint other doctors in the group to perform HH. Immediately afterwards, another doctor in the same group performed HH.

- The lack of 7 steps

During observation, it was common that HCWs did not comply with 7 steps as suggested by WHO, neither did they fulfil the 6 steps in China's standard. Instead, they just rubbed their hands casually during HH. This suggested that the problem lied in poor staff behaviour, rather than the late adoption of standard by the government.

- Practice of consultation- patients rushed in

It was noted that during a consultation, the next patient in the queue would rush inside the consultation room before end of the previous consultation, possibly causing the lack of HH among HCWs.

- Performing hand wash at the end of rounds

HCWs usually performed hand wash at the end of rounds. HH was possibly seen as a means of self-protection.

- Behaviour: Interviewing HCWs and managers

- HCWs did not follow 7 steps

A MCHH Obstetrics doctor "Ah, actually, we are not really keeping up here, and we do not follow the 7-steps washing method."

- HCWs performed HH mainly after providing treatment to patients

A MCHH Obstetrics doctor "After the surgery was done, we always washed [hands]. But we don't really wash before surgery."

- Role of Hawthorne effect during observation

PH ICD manager, translated. "Seeing [the observer] they will do it, [compliance] will be raised. That is the so-called Hawthorne effect."

- Gloves as alternative to HH

PH Stomatology Department Head doctor, translated. "Doctors do not perform hand hygiene before performing surgery on patients, [they] only wear gloves."

- Nurses generally had higher compliance than doctors

A TCM doctor, translated. "For nurses, basically they have no problem. For doctors it depends on individuals. Some are not used to it then they do not really wash."

- HCWs had developed HH habits

A MCHH Obstetrics doctor, translated. "In fact, it has been a habit for many years, it is too troublesome, isn't it? It must be troublesome, just wash it [casually]."

- Attitude: Interviewing HCWs

- Reasons to not perform HH: Being busy and forgetfulness

A PH nurse in the examination department who didn't perform HH, translated. "Sometimes HH actions are missed, and there are times that [I] did not perform hand hygiene. Right, [because I] forgot."

TCM ICD manager, translated. "Sometimes [we are] too busy, because health care workers you know, sometimes they are in a hurry, maybe they forget to hand wash."

- Reasons to not perform HH: Poor medical system and people's quality

PH Vice Chief, translated. (What are the reasons for low hand hygiene compliance?) "In addition to busy work, quality [of people] includes many things: education, roots of culture, working ability, self-discipline." "Lack of talent, professional skills and resources, it is difficult to improve."

PH Stomatology Department Head doctor, translated. "[Patients] rush in, four- fifty patients following, even do not have enough time to go to the bathroom. Patients are in a hurry and quarrelled."

- Costs of HH resources were partly borne by HCWs to avoid misuse of resources, reducing the incentive for HCWs to perform HH

TCM ICD manager, translated. "Because the wards have to use the hand rub, and also the disposable towel. Because now the wards are accounting for costs, some wards they want to reduce costs, and compliance will be reduced. They do not use it every time when they should. They do not use it every time when there are hand hygiene indications."

- HCWs performed HH because of high awareness among Pediatrics patients' family

A PH Pediatrics nurse, translated. "Hand washing is very important, especially for us in Pediatrics."

- HCWs performed HH after work to protect their own family

A MCHH Obstetrics doctor, translated. "Like me, every time before going home, [I] have to wash [my hands]. Because [we have] kids at home, [I] worry. Every time before home I will wash hands."

A PH Pediatrics nurse, translated. "Especially when we come off work, we have to change clothes and wash hands, as we have elderly and kids at home."

- Inadequate HH infrastructures

A CDC doctor "[Hand hygiene infrastructures] is poor. Hand rub is placed there, no one uses."

- Self-discipline was important to improve HH

PH ICD manager, translated. "But it is difficult to do well why? Because they need to have self-discipline."

- Attitude: Interviewing PH ICD staff

HCWs at the ICD of PH first rejected our suggested HH interventions. The suggested interventions included HCWs and patient education, putting up posters, playing promotional video on hospital television. Reasons behind the rejection was: HCWs were busy and had no time to improve HH; no one cared about posters; patients could not understand the importance of HH as some of them were illiterate. Besides, they saw HH more as a performance indicator, less as a means to reduce HAI. They denied HCWs had poor HH knowledge, implying that low HHC was due to deliberate disobedience.

Beliefs of decision makers were successfully influenced. In an interview 2 months later, their attitude was changed to become positive and supportive. They had also concretely planned out interventions, which were similar to previously suggested HH interventions. The interventions included: HCWs education, patient engagement, playing promotional video. They were committed to new changes and ongoing improvements. This could be explained by stages of change model- from pre-contemplation to action. However, there was still refusal of international standard.

- Attitude and other themes: Focus group

In total, 6 main themes about HH were generated.
A. Reasons to not perform HH: cold water, lack of sink, lack of towels, busy, patient overcrowding, urgency, laziness, people's quality, poor medical system causing patients to rush in, patient feeling offended, no obvious dirt.
B. Reasons to perform HH: training and checking by ICD, self-protection, habit, high awareness among Pediatrics patients' family.
C. HCWs used gloves as alternative to HH, as the former was perceived as more convenient.
D. HCWs suggested solutions to improve HHC: better HH resources, current regular trainings, self-compliance.
E. HCWs claimed that they had good HHC. Besides, nurses generally had higher compliance than doctors.
F. There was an obvious leadership hierarchy among HCWs.

Discussion

It was noted that knowledge, attitude and behaviour of HH among HCWs in all public health care facilities in Yongping were poor at baseline. Therefore, multimodal HH interventions with reference to WHO multimodal HH improvement strategy were implemented. Effectiveness of multimodal HH interventions was evaluated. Besides, reasons behind their poor HHC were explored.

- Effectiveness of multimodal HH interventions

The interventions inspired by WHO multimodal HH improvement strategy were effective in improving HH knowledge, attitude and behaviour of HCWs and should be used to improve HHC. Post-intervention HHC rate increased compared to baseline. In addition, a change in attitude of PH ICD staff was noted. However, HHC was still lower than the worldwide median rate, showing that further improvement on HHC was needed.

- Reasons for HCW to not perform HH

- Denial of existing problem

"Hand Hygiene Knowledge Questionnaire for Health-Care Workers" objectively showed that knowledge gaps on HH did exist. However, PH ICD manager did not agree with the results, denying the problem. Besides, HCWs in focus groups claimed that they had good HHC, which was opposite to reality.

- Medical system limitation

It was a culture that patients rushed into the consultation room before they were told, causing a lack of HH among HCWs. Also, the cost of HH resources were partly borne by HCWs. Other problems of the medical system like patients overcrowding and urgent patients existed, causing HCWs to not perform HH.

- Lack of resources

From "Ward Infrastructure Survey", health care facilities had deficiencies in HH infrastructures. The infrastructures included: sink with clean water, soap, disposable towel, alcohol based hand rub, posters and reminders on HH technique and indications. In focus groups and interviews, HCWs commented that there were not enough HH infrastructures. In addition, cold water problem caused a low HHC rate.

- People's quality

It was mentioned that HCWs' quality and self discipline affected HHC. Patients' quality was a reason too- they were illiterate and could not understand their role in monitoring HCW's HH behaviour, and some may feel offended when HCWs performed HH after providing treatment to them.

- Lack of awareness among HCWs

Some HCWs mentioned they did not perform HH because there was no obvious dirt, some because of convenience. PH ICD manager saw HH only as a performance indicator, and refused to adopt the international HH standard. These showed HCWs did not have enough awareness on the importance of HH.

- Other priorities

HCWs mentioned that they were too lazy to perform HH. Some used gloves as alternative to HH out of convenience. These showed that they prioritised comfort and convenience over HH.

- Deep-rooted culture

HCWs mentioned that whether HCWs performed HH was a matter of habit. The lack of 7 steps in HH was noted in observations and interviews, and was a culture in the hospital. It was also a culture for nurses to perform HH better than doctors. As leadership hierarchy was a part of their culture, using a leader as a role model for HH may be a solution to increase HHC rate.

- Reasons for HCWs to perform HH

- Being observed

With the presence of CCTV, compliance in PH neonatal ward was especially high. Besides, under Hawthorne effect during observation, higher HHC rate was noted. HCWs mentioned in focus groups and interviews that one of the reasons for them to perform HH was due to a high awareness among Pediatrics patients' family. HCWs also mentioned in focus groups that they needed to have better HHC due to constant checking by ICD.

- Self-protection awareness

From interviews and focus groups, HCWs mentioned that they usually washed their hands after treatment for patients. Also, after work to protect their family. They mentioned using gloves as alternative to HH, as gloves had a better self-protection effect. From observation, HCWs washed their hands at the end of rounds. It could be implied that HCWs performed HH due to an awareness to protect themselves. However, WHO "Glove Use Information Leaflet" states that in no way does glove use modify HH indications or replace HH action by rubbing with an alcohol-based product or by hand washing with soap and water. Therefore, the practice among HCWs was in fact inappropriate.

Conclusion and Future Directions

HH practice among HCWs was poor in hospitals in a rural county of Southwestern China. The problem of poor HH practice was multifactorial. The interventions were inspired by WHO multimodal HH improvement strategy. They were effective in improving HH knowledge, attitude and behaviour of HCWs and should be used to improve HHC. Post-intervention HHC rate increased compared to baseline. In addition, a change in attitude of ICD staff was noted. However, HHC was still lower than the worldwide median rate, showing that further improvement was needed. Interventions will be continued and HHC rate will be followed up, hopefully to improve HH practice of Yongping HCWs in the long term.