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SYSTEMATIC REVIEW ON THE PREDICTORS OF KNOWLEDGE AND PRACTICE ON STANDARD PRECAUTIONS (SP) AMONG HEALTHCARE WORKERS (HCWS)

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ABSTRACT

Background: Standard Precautions (SP) is important in preventing healthcare-associated infections (HAI) as well occupational infection among healthcare workers (HCWs) in healthcare facilities. However, the knowledge and practice of SP among HCWs is still poor.

Objectives: To identify the predictors for knowledge and practice of Standard Precautions among HCWs.

Materials and Methods: Articles were searched using Pubmed, Medline, Scopus and Google Scholar search engines using keywords "Standard Precautions OR infection control AND knowledge practice". Types of studies included are analytical observational studies. Only English articles published from 2010 to 2018, accessible as full texts and evaluating multiple components of Standard Precautions were included in the review.

Result: There are 10 articles included in this study. Several predictors had been identified through this review such as age, marital status, clinical experience, knowledge, administrative role, grade of hospital and working department, training, history of blood and body fluid exposure and constructs of Health Belief Model (HBM).

Conclusion: HBM's construct is among the important predictors of knowledge and practice on SP. Program aiming at comprehensive education and training about knowledge and practice on SP tailored to the HBM's construct could help improve the compliance with SP among the HCWs in order to reduce the chances of occupational exposure to infections.

Keywords: Standard Precautions, predictors, healthcare workers, knowledge and practice, infection control.

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1.0 Introduction

Standard Precautions are a set of infection prevention and control (IPC) practices that can prevent transmission of diseases acquired by contact with blood, all body fluids, secretions, excretions except sweat regardless of whether they contain visible blood or not, non-intact skin including rashes as well as mucous membranes. They are meant to reduce the risk of transmission of microorganism from both recognized and unrecognized sources regardless of patients' diagnosis and perceived infection status (Centers for Disease Control and Prevention, 2016; Ministry of Health Malaysia, 2002; World Health Organization (WHO), 2007). Among the SP practice are hand hygiene, respiratory hygiene, appropriate use of personal protective equipment (PPE), disinfection and sterilisation of medical equipment, housekeeping and management of sharps and clinical wastes disposal (WHO, 2007; Siegel, Rhinehart, Jackson, & Chiarello, 2007).

It is very crucial and fundamental to empower HCWs to practice SP in order to prevent healthcare-associated infection (HAIs) among patients as well as occupational infection among HCWs. HAIs is an infection acquired by a patient during receiving cares in any healthcare facility which was not present during the time of admission. HAIs and occupational infections have resulted in prolonged hospital stays and disability of patients, excess mortality, increased antimicrobials resistance, increased the financial burden of the health organization as well as psychosocial and economic impacts on the patients and their family. When it affects the HCWs, it will give a bad impact to the quality and productivity of the healthcare services provided (WHO, 2011; Andersson, Bergh, Karlsson, & Nilsson, 2010).

According to a study on burden of endemic HAIs, the prevalence in developing countries (varies from 5% to 19%) were markedly higher when compared to those in developed countries (varies from 5.1% to 11.6%) (Allegranzi et al., 2011; WHO, 2011). The most common HAIs among patients are respiratory infections such as pneumonia and lower respiratory tract infections (LRTI) (22.8%), urinary tract infections (UTI) (17.2%) and surgical site infections (SSI) (15.7%) (Health Protection Agency, 2012). Apart from that, HCWs are also at high risk to get HAIs such as Human Immunodeficiency Virus (HIV), Tuberculosis (TB), Hepatitis B virus (HBV) and Hepatitis C virus (HCV) as a result of percutaneous exposure to contaminated sharps and also airborne infections at the workplace (Occupational Safety & Health Administration U.S. Department of Labor, 2017). The most common occupational infection was chicken pox (66.7%), followed by measles (29.2%) and pulmonary tuberculosis (4.2%) (Assiri, Hathout, Anwar, Dalatony & Kader, 2013).

A systematic review have found convincing evidence that improvements in SP such as hand hygiene practice will lead to reductions in transmission, colonization and infection by multi-drug resistant (MDR) bacteria thus reducing HAIs worldwide (WHO, 2014). In fact, the SP measures are also simple, low-cost and effective (WHO., 2011). In spite of widespread adoption of SP policy by organisations, there are still lacking in their practice as they require accountability and behavioural change in order to be implemented (Clock, Cohen, Behta, Ross, & Larson, 2010). Because of that, many studies have been done to determine the predictors of knowledge and practice of SP among HCWs. The objective of this review is to identify the predictors of knowledge and practice of SP among HCWs.

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2.0 Materials and Methods

A review was conducted to search for articles on the factors associated with SP knowledge and practice. Articles were searched using Pubmed, Scopus, Medline and Google Scholar search engines. The keywords of "knowledge practice AND infection control" and "knowledge practice AND Standard Precautions" were applied to obtain the literatures. A total of 789 articles were initially found from the search engines. Duplication of articles were removed and 722 articles underwent primary screening to look for its relevancy based on titles and abstract.

After screening, 98 articles underwent secondary review for eligibility. Inclusion criteria included articles published in English from 2010 to 2018 and also accessible as full texts. Types of study included in this review are analytical observational studies such as cross sectional, case control and cohort studies for comparison of the predictors of knowledge and practice on SP among HCWs. Among all, only those involved with multivariate level of analysis and evaluated multiple components of SP were included in the review. We excluded studies that evaluated only one component of SP such as hand hygiene or injection safety only. Reviewed articles were excluded as per the exclusion criteria. Finally, 8 articles were included as the final literature search. The flow diagram is illustrated in the Figure 1 and the result are summarised in Table 1 (Moher et al., 2009). For additional records from other sources (in Figure 1), there is no available record such as thesis or dissertation on predictors of SP was identified through Universiti Putra Malaysia's library.

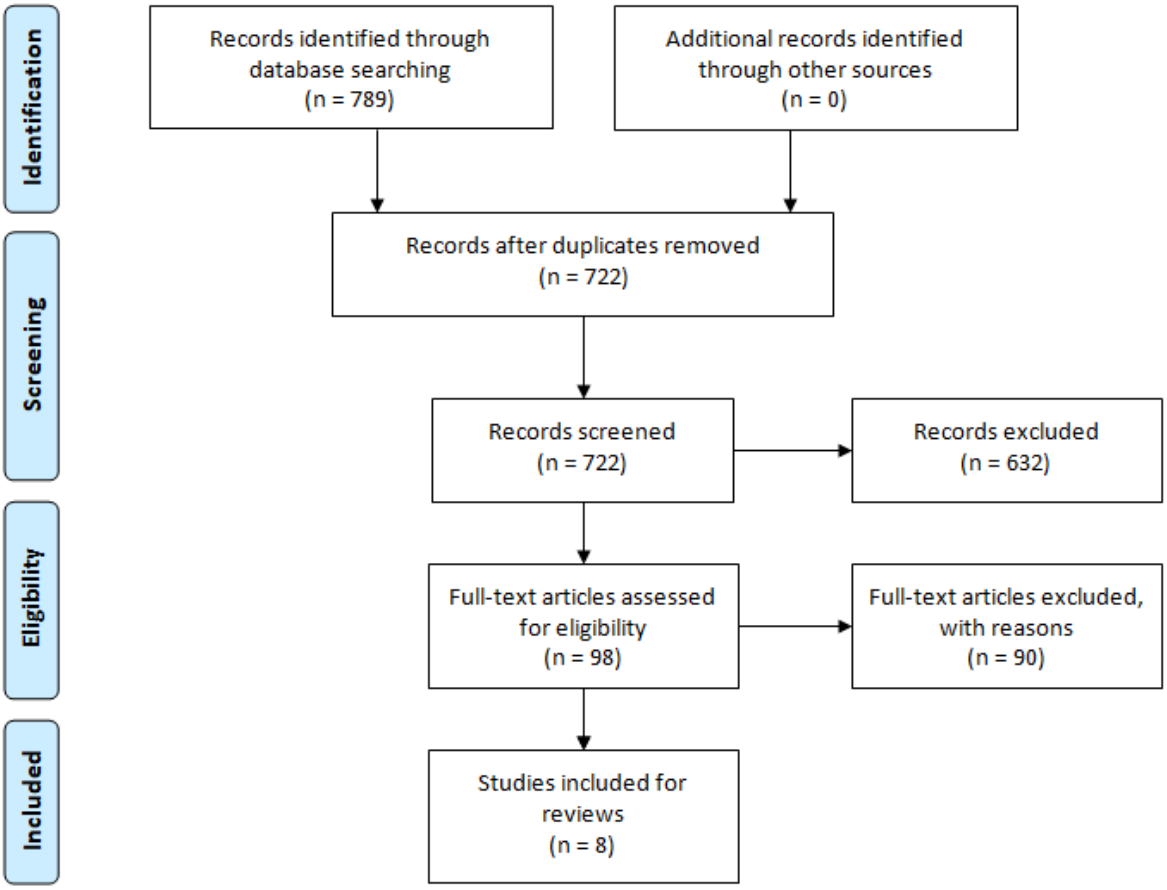

Figure 1: PRISMA 2009 flow diagram of literature search

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3.0 Result

Table 1: The result of systematic review on predictors of knowledge and practice of Standard Precautions.

Author, year of publication	Study population and country	Type of study	Methods and instruments	Factors/Findings
Luo, He, Zhou, & Luo, 2010	1500 registered nurses from 18 hospitals in Hunan, China	Cross sectional study	Self-reported questionnaires on: 1. Sociodemographic 2. SP knowledge 3. Compliance with SP 4. General self-efficacy scale.	The statistically significant predictors of SP compliance were: 1. Training (OR=2.17, 95% CI=1.85–2.55) 2. Knowledge (OR=1.94, 95% CI=1.01–3.41) 3. Hospital grade (big hospital) (OR=1.61, 95%CI=1.79–1.86) 4. Presence of sharps disposal box (OR=1.43, 95% CI=1.10–3.41) 5. Self-efficacy (OR=1.29, 95% CI=1.04-1.59) 6. Department/unit (surgical) (OR 1.24, 95% CI 1.05–1.46). 7. Exposure experience (OR=0.69, 95% CI=0.56–0.85)
La-Rotta, Garcia, Barbosa, Santos, Amanda Ferreira Vieira, & Carneiro, 2013	208 randomly selected health professionals; 93 of them were residents and 115 were physicians at a Brazilian Clinical Hospital.	Cross sectional study	Interview and semi-structured questionnaires on: 1. Knowledge of the SP 2. Knowledge of biosafety, 3. Compliance with SP	The statistically significant predictors of knowledge of the SP were: 1. University of graduation (private) (β:-1.022; 95% CI:-1.793-0.251; $p < 0.009$) (private university graduates has less knowledge on SP as compared to public university graduates) 2. Knowledge of biosafety (β: 0.623; 95% CI: 0.046 to 1.199; $p < 0.034$) (those with better knowledge on biosafety have better knowledge on SP) The only statistically significant predictor of compliance with SP was marital status (being married) (β:-2.113; 95% CI:-3.511-0,714; $p < 0.03$)
Amoran & Onwube, 2013	1,680 HCWs (1,357 in government and 323 in private hospitals/clinics) in Northern Nigeria.	Cross sectional study	Self-administered questionnaire on: 1. Demographic characteristics 2. Knowledge of infection control 3. Universal precaution practice	The only statistically significant predictor of practice of SP was exposure to blood and body fluid in the last 6 months (OR= 4.56, 95% CI=1.00-21.28).
Arafa, Mohamed, & Anwar, 2016	400 nurses in the Beni-Suef University Hospital in Egypt.	Cross sectional study	Self-administered questionnaire on: 1. Sociodemographic characteristics 2. Knowledge of infection control 3. Practice of infection control	The only statistically significant predictor of infection control practice was role of administration (OR: 2.71, 95% CI: 1.78–3.42, P=0.026).

			4. Role of administration	
Zhou et al., 2014	647 HCWs who consist of 199 physicians and 448 nurses from six hospitals in China	Cross sectional study	Self-administered questionnaire on: 1. Knowledge on HAI 2. Attitude towards safety 3. Self-reported practice	The only statistically significant predictor of SP prevention knowledge among nurses was work experience (β:-0.52, P<0.001) (the longer duration of work have better knowledge on SP)
Yousafzai, Janjua, Siddiqui, & Rozi, 2015	485 HCWs from 365 primary healthcare clinics in Pakistan.	Cross sectional study	Interview and questionnaire on: 1. Each construct of HBM 2. Knowledge on BBP infection 3. Compliance with UP	The statistically significant predictors of compliance to Universal Precautions (UP) were: 1. Blood borne disease transmission knowledge (β: 0.69, 95% CI: 0.54-0.84, P<0.001). 2. Self-efficacy (β: 0.60, 95% CI: 0.28-0.93, P<0.001). 3. Perceived barriers (β:-0.28, 95%, CI: -0.41- -0.15, P<0.001). 4. Perceived benefits (β: 0.40, 95% CI: 0.05-0.75, P=0.026). 5. Perceived severity (β:-0.37, 95% CI:-0.62- -0.11, P=0.005). 6. Perceived Susceptibility (β: 0.25, 95% CI: 0.004-0.49, P= 0.046).
Colet, Cruz, Alotaibi, Colet, & Islam, 2017	236 nursing students in a university in Riyadh province, Saudi Arabia.	Cross sectional study	Self-administered questionnaire on compliance to SP.	The statistically significant predictors of compliance to SP was: 1. A duration of 1-2 years of clinical experience (β: 8.865, 95% CI: 1.88-15.85, p< 0.05). 2. A duration of 3-4 years of clinical experience (β: 9.491, 95% CI: 1.61-17.37, p< 0.05).
Phing & Chee, 2016	162 medical students in clinical year in a public university, Malaysia.	Cross sectional study	Self-administered questionnaire on: 1. Sociodemographic 2. Knowledge on SP 3. Attitude on SP 4. Practice on SP	The statistically significant association with SP practice: 1. Knowledge (p <0.001) 2. Attitude (p<0.001) The only statistically significant predictor of SP practice is age (OR: 1.502, p=0.012)

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4.0 Discussions and Recommendations

4.1 Sociodemographic

The age of respondents was among the statistically significant predictors of knowledge and practice on SP. According to Phing & Chee (2016), for every one year increase in age, the respondents were 1.5 times (p=0.012) more likely to have knowledge score above 75th percentile. This finding is significantly important since the age of the onset of blood borne disease such as HIV infection has decreased considerably over the past decade. There is a need to concentrate efforts to increase knowledge and practice regarding HIV and its prevention among adolescents and young adults especially among HCWs. In addition, it is believed that young peoples' ability to protect themselves against disease transmission and HAIs was low to moderate as compared to older age (Phing & Chee, 2016).

Marital status was also among the significant predictors of compliance with the universal precautions (La-Rotta et al., 2013). Married doctors show better compliance with the SP than single professionals. There is possibility that the fear of getting infected by infectious diseases can lead to social and medical implication to other family members. This has led to better compliance with SP among these married HCWs.

4.2 Knowledge and Attitude

Amongst the factors found to be associated with good knowledge of the SP is the level of knowledge of biosafety (La-Rotta et al., 2013). It can be concluded that the HCWs with good knowledge of biosafety subjects also know more about SP, although it was not completely. Phing & Chee (2016) also found that the knowledge and attitude is positively correlated with compliance towards SP. Luo et al., (2010) in their study showed that knowledge exerts a positive impact on compliance with SP (OR 1.94) (see Table 1). Those with better knowledge on SP tend to practice more precautions. From the finding, it could be interpreted that there is a need for further improvement in the knowledge and attitude level on SP among the respondents; which will hopefully improve their practice. The low level of knowledge and attitude among the respondents may be due to lack of specific educational courses conducted among them.

4.3 Administrative role

Arafa, Mohamed & Anwar (2016) in their study showed that the administration score was the only significant determinant for practice on SP (AOR: 2.71, 95% CI: 1.78–3.42, P=0.026). Self-reported scoring by the HCWs found that 38.7%, 40.3% and 21.0% of them reported poor, fair and good administrative role in their clinics respectively. The items being reported consist of the availability of sink for washing hands in the clinic, enough provision of gloves, masks and safety boxes, supervision on the infection control measures by the management, regular evaluation of infection control practice, health screening during pre-employment and while working, related training given before and during working and also Hepatitis B vaccination. Administrative role as a significant predictor of SP practice could be explained by the relationship between administration and the knowledge and skills acquired through training on the importance of SP practices and its role in decreasing healthcare-related

morbidities. Decreasing healthcare-related morbidities subsequently will lead to a better and safe healthcare facility environment. This will hopefully result in better implementation of SP policy, which will consequently improve HCW practices in decreasing the incidence of healthcare-associated infections.

4.4 Years of work or clinical experience

Longer duration of clinical experience were associated with more rigorous compliance with SP (Colet et al., 2017). Experience has been described as the most essential factor affecting the development of skills. Direct experience is an invaluable tool in achieving psychomotor skill development and enhancement of decision-making (Khomeiran, Yekta, Kiger, & Ahmadi, 2006). For example, for nurses, the longer they worked, they gradually get more practice in the nursing procedures that necessitate them to use standard precautions, and their skill competency improved. In addition, HCWs who had been working longer duration as compared to the new one are more familiar with the hospital's guidelines and protocols regarding infection control and prevention, thus increasing their practice of SP. Longer clinical experience might contribute towards refining the performance in the adoption of SP (Colet et al., 2017). Another study conducted among doctors also supported that good predictors of knowledge on SP are years of experience and workplace training (Sax et al., 2005).

However, another study conducted among nurses in China has found that the SP knowledge was inversely associated with work experience (Zhou et al., 2014). There are several possible explanations for this knowledge deficit among those with more work experience. This probably due to the curricula across Chinese medical and nursing schools which are rather uniform, with little, if any, emphasis on health-associated infections and its precautions. Besides, the related theoretical knowledge from the school is neither revisited nor reinforced under clinical settings in the internship years, in the National Medical Licensing Examination (NMLE), or in clinical practice, therefore allowing theoretical knowledge to wane over time (Huang, Xie, Zeng, Law, & Ba-thein, 2013). Whereas the practical knowledge, the precautions in particular, is not acquired further through professional experience, leaving the respondents with knowledge gaps in developing concepts of infection control.

4.5 Recent history of exposure to blood and body fluid

Recent history of exposure to blood and body fluid affect SP practice. Amoran & Onwube, (2013) found a higher proportion HCWs who were exposed to blood products and body fluid began to practice universal precaution out of fear of acquiring infectious diseases. As a consequence of inconsistent use of universal precautions, HCWs put themselves and their clients at a potential risk. African HCWs are in fear of occupational exposure, which may further undermine their morale. Instituting of a surveillance system for HAIs is therefore recommended to improve consistent use of universal precautions among HCWs, especially in the African countries.

However, another research done by Luo et al., (2010) documented the opposite findings. Compliance to SP among nurses without exposure was found to be greater than those with exposure. It appears that greater compliance with the SP results in less contamination experience. This proves that the use of the SP had reduced the chances of occupational

exposure to biological hazards.

4.6 Hospital grade and working department

A study by Luo et al., (2010) showed the high impact of hospital grade and working department on individual's compliance with the precautions. In their survey, it was found that SP practices among nurses in the smaller hospitals were not as good as those in the general or bigger hospitals. The reason for this may be that in the smaller hospitals it have only basic facilities, lack of good infrastructure, and have no dedicated infection control administration unit. Therefore, not enough emphasis is put on the infection control practice in the hospital.

In terms of nurses working in different departments, the compliance to SP in the medical departments was lower compared to those in the surgical departments. This difference was found to be statistically significant ($p < 0.05$), and is probably as a result of the large number of elderly patients with chronic medical illnesses who are treated in the medical wards. These results indicate that the administration departments staffs should focus on doing comprehensive infection control monitoring especially in the smaller hospitals and in the departments which are busy or having more patients.

4.7 Constructs of Health Belief Model

Result of a study in Pakistan provides evidence that constructs of Health Belief Model (HBM) explain better on the compliant behaviour of HCW in practicing SP. The knowledge on blood-borne pathogen (BBP) transmission ($p<0.001$), the perception regarding benefits of compliance with SP ($p=0.026$) and perceived susceptibility to BBP at workplace ($P=0.046$) were significant and positively associated with compliance to SP (Yousafzai et al., 2015). HCWs who have knowledge on modes of transmission of BBP might have better perception regarding susceptibility to workplace infections and benefits of compliance with SP.

HBM also states that behaviours could be modified if the severity of the condition or disease as a result of that behaviour is perceived to be more severe (Rosenstock, 1974). For example, those who perceived to be more likely to get more severe workplace infection will comply more with SP and will be less likely to sustain from needle stick injury. However, the opposite finding was found in this study (Yousafzai et al., 2015). There is a significant negative association between perceived severity and compliance with SP ($P=0.005$) which can be explained by the reverse causality (Yousafzai et al., 2013). Those who have poor compliance to SP are more likely to sustain needle stick injury and thus increasing the perceived susceptibility and severity of blood borne infections.

As for the perception regarding barriers to comply with SP practice, there is a significant negative association between perceived barrier and compliance to SP practice (Yousafzai et al., 2015). For a successful program or intervention to improve the compliance with SP, it is important to identify and address the perceived barriers first. Addressing any individual factor in improving the compliance with SP will not work in isolation. Addressing structural barriers, individual attitude and behavioural factors together simultaneously might be effective in improving the compliance with SP. Apart from that, improving knowledge and perceptions on SP could be the first step towards improving the occupational safety of HCW at workplace. Giving interventions such as providing ongoing training, and enhancing

awareness regarding SP might be helpful in improving knowledge, perceptions and thereby SP compliance among HCWs.

4.8 Self-efficacy

Another predictor of SP is self- efficacy. Self-efficacy is the core concept of Bandura's social cognitive theory and is the confidence to control and guide one's own activities when they deal with changeable environments and in facing new experiences (Bandura, 1994). Luo et al., (2010) in their research results revealed a positive correlation between general self-efficacy and compliance with the SP ($r=0.21$, $P<0.001$). They also found that, at the multiple regression analysis, general self-efficacy is a predictor of SP compliance (AOR 1.29, 05% CI: 1.04–1.59). This means that the odds to comply with SP is 1.3 times higher among nurses with higher self-reported score on validated self-efficacy in practicing SP as compared to those with lower score (Luo et al., 2010). Strong perception about self-efficacy results in people's high assurance in practicing SP. For example in another study, perception about self-efficacy in practicing SP during different circumstances was positively associated with compliance to SP ($P<0.001$) (Yousafzai et al., 2015).

According to the HBM, the formation of health beliefs is critical for the acceptance of advice, the correction of misconduct, and the adoption of health activities (Rosenstock, 1974). Most health behaviour theories suggest that the most proximal (immediate) influences on health behaviour are attitude, social influence, self-efficacy, and intention of change variables (Noar, Chabot, & Zimmerman, 2008). Future interventions in targeting for the improvement of compliance with SP should focus on strengthening the self- efficacy by providing hands on experience in performing different procedures of SP.

5.0 Conclusion

In summary, many predictors in determining the knowledge and practice of SP among healthcare personnel had been identified through this review. In order to reduce hospital infections and to protect the health of patients and medical staffs, the relevant authorities and hospital infection control department personnel should pay more attention to HCWs compliance with the standard precautions, to organise more standard precautions training, and to provide sufficient practical personal protection equipments. Through learning, the attainment of knowledge and skills, and the formation of health beliefs and attitudes, as well as health activity habits can be formed. Only when individuals are familiar with the content and meanings of the standard precautions, with strengthening of the individual's health concepts, can individual practice changed so as to improve compliance with the standard precautions.

In the mean time, infection administration departments should gather more information on healthcare-associated infections and provide immediate feedback from the monitoring results in order to strengthen the education and dissemination of the standard precautions among HCWs. The educational intervention should be strengthened so as to improve concepts of health and general self-efficacy, to increase compliance with the standard precautions and hence reduce the chances of occupational exposure and hospital infection. Program aiming at

comprehensive education and training about knowledge and practice on SP tailored to the HBM's construct could help improve the compliance with SP among the HCWs. Therefore, effectiveness of interventions based on HBM to enhance the compliance with UP among HCW at FLCF should be investigated through experimental design as future research recommendation.

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Authors' contribution

Author 1: literature finding, draft manuscript
Author 2: manuscript review and editing

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