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Medical waste management-related factors affecting health and experiences of health risks among medical waste handlers in low and middle-income countries: a systematic review protocol of qualitative studies

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ABSTRACT

Introduction Medical waste management (MWM)-related factors affecting the health of medical waste handlers (MWHs) and their health risks in low and middle-income countries (LMICs) are an important public health concern. Although studies of MWM-related factors and health risks among MWHs in LMICs are available, literature remains undersynthesised and knowledge fragmented. This systematic review will provide a comprehensive synthesis of evidence regarding the individual, system and policy-level MWM-related factors that affect MWHs' health and their experiences of health risks in LMICs.

Methods and analysis All qualitative studies published in peer-reviewed journals between 1 July 2011 and 30 June 2021 with full texts available and accessible will be included in the review. Seven specific electronic databases (eg, Scopus, Ovid MEDLINE, EMBASE, Global Health, CINAHL, ProQuest and PsycINFO) will be searched. Two authors will review the citations and full texts, extract data and complete the quality appraisal independently. A third reviewer will check discrepancies when a consensus cannot be reached on differences between the two reviewers. Data extraction will be conducted using the Joanna Briggs Institute standardised data extraction form for qualitative research. The quality of articles will be assessed using a Critical Appraisal Skills Programme checklist. Results from eligible articles will be synthesised into a set of findings using the thematic framework analysis approach and will be reported according to the Enhancing Transparency in Reporting the Synthesis of Qualitative Research statement.

Ethics and dissemination This review is based on published articles, which does not require ethical approval because there is no collection of primary data. Findings from this review will be published in a peer-reviewed journal and presented at relevant public health conferences. This protocol has been registered with the International Prospective Register of Systematic Reviews (PROSPERO).

PROSPERO registration number CRD42020226851.

Strengths and limitations of this study

- The primary strength of the systematic review is that it will bring together the current knowledge in the area of medical waste management (MWM)-related factors affecting the health of medical waste handlers (MWHs) and their experiences of health risks in low and middle-income countries (LMICs). This review will develop a context-specific comprehensive understanding of the individual, system and policy-level MWM-related factors that affect the health of MWHs, and their experiences of health risks.
- To the best of our knowledge, this review will be the first evidence synthesis of the individual, system and policy-level MWM-related factors that affect MWHs' health, and their experiences of health risks in LMICs using a systematic approach.
- This review will only include studies published in the English language. Excluding studies published in languages other than English may produce publication bias and impact generalisability.

BACKGROUND

The healthcare sector in low and middle-income countries (LMICs) is growing fast[1] due to rapid population growth, and concomitant increased use of medical services[2] generates increased medical wastes (MW).[3] Low-income countries are those with a gross national income (GNI) per capita, calculated using the World Bank Atlas method, of $1045 or less in 2020. Lower middle and upper middle-income countries are those with a GNI per capita from $1046 to $4095 and $4096 to $12 695, respectively.[4] According to the WHO,[5] MWs refer to wastes and by-products generated by healthcare and medical

research settings, including medical or diagnostic centres and hospitals. While most MWs are not hazardous, around 15% of them are considered dangerous wastes.[3 6] These hazardous MWs may be infectious (contaminated blood, cultures and stocks of contagious agents), sharps (syringes, needles, disposable, etc), cytotoxic (eg, wastes comprising cytostatic drugs—commonly used in cancer therapy, genotoxic chemicals), radioactive (eg, unused liquids from radiotherapy or laboratory research, contaminated glassware, packages or absorbent paper; urine and excreta from patients treated), chemical (disinfectants, sterilants, heavy metals, etc) or pharmaceutical (expired, unused and contaminated drugs and vaccines).[5–8] These wastes contain pathogenic micro-organisms that may enter into human bodies, especially in medical waste handlers (MWHs) in LMICs, through various routes, including punctures, abrasions or cuts in the skin, inhalation and ingestion.[3] Thus, MW constituents have the potential for injury and infection.

Health risk can be characterised as the probability of a situation or an event and its consequences related to infectious diseases (hepatitis B and C, HIV and COVID-19) and other health complications (eg, respiratory disorders, cancer, burn and skin irritation) of individuals' (eg, waste handlers) health.[9] MWHs, particularly those in LMICs,[10] are potentially at a higher health risk to various injuries and infections due to the manual sorting of dangerous materials at waste disposal sites.[3] Compared with high-income countries, medical waste management (MWM) in LMICs is not well equipped with the resources and capability to reduce health risks of MWHs. Additionally, the good MWM practices are not followed by waste handlers due to inadequate education and training.[11] Furthermore, the emergence of the COVID-19 pandemic has resulted in increased dangerous MWs from increased use of personal protective equipment[12] such as gloves, surgical masks, goggles or face shields, gowns, respirators (ie, KN95 or FFP2) and aprons.[13] Improper management of these used infectious MWs, especially in LMICs, may increase the risk of injuries and infections, including the COVID-19, hepatitis B and C and sharps-inflicted injuries, among MWHs.[14 15]

Although studies of the individual, system and policy-level MWM-related factors affecting the health of MWHs and their health risks in LMICs are available,[16–18] the findings of these studies were not systematically synthesised. Systematically identifying, collating, synthesising and appraising available literature will provide a comprehensive understanding of the individual, system and policy-level MWM-related factors affecting the health of MWHs in LMICs and their health risks and help inform future health policy and practices related to MWM in LMICs. Furthermore, systematically synthesising various findings of available studies may help LMICs, which may not follow the best available MWM practices and can learn from similar settings, thus improving their MWM. This sets a strong rationale for synthesising available evidence and understanding gaps through this review and suggests recommendations for improving MWM and reducing health risks. Therefore, this systematic review will identify, appraise and synthesise qualitative evidence on the individual, system and policy-level MWM-related factors that affect MWHs' health in LMICs and explore common health risks experienced by them in LMICs. The review will answer the following questions: (1) what are the individual, system and policy-level MWM-related factors affecting the health of MWHs in LMICs? and (2) what are common health risks experienced by MWHs in LMICs?

METHODS

This protocol is informed by the standard Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols reporting guidelines[19] (see online supplemental file 1). This review will use the Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ) statement to report the thematic synthesis of qualitative studies.[20 21] The ENTREQ statement aids investigators in reporting the phases most usually related to the synthesis of qualitative health research, including searching and selecting qualitative studies, quality appraisal and methods for synthesising qualitative findings.[20]

Patient and public involvement

No patient was involved.

Search strategy

In this review, the following seven electronic databases will be searched for relevant studies in the past 10 years: Scopus, Ovid MEDLINE, EMBASE, Global Health, CINAHL, ProQuest and PsycINFO. In the case of relevant publications which might have been missed during the initial search, a further search of the bibliographical references of all eligible publications, complemented by citation tracking using Google Scholar, will be conducted. A search strategy will be developed on MEDLINE and adapted to other databases as shown in online supplemental file 2. The search will apply truncations (*) and Boolean operators ('AND', 'OR' and 'NOT') depending on the specifications of the databases. A research librarian will be consulted to finalise the search strategy. A search log will be kept for accountability and transparency. Two authors (MNH and TGH) will identify relevant literature, run a screening using titles and review abstracts during the literature search. Final selection will be accomplished by reviewing full texts and applying eligibility criteria to include studies aligned with the research objectives. Database searches will be rerun prior to the final analysis to ensure any recent publications are included in the review. The search will be limited to English literature only since we have limited or no financial and logistical capacity to retrieve and translate articles published in languages other than English.

The search strategy will include all possible search terms, keywords and phrases relevant to the topic. As

per a database of interest to conduct the search, we will apply a multipurpose (.mp) search across several fields, including title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word and unique identifier, to have efficient search outputs. The search strategy will use the following key terms: 'medical waste', 'waste management', 'training', 'knowledge', 'technology provision', 'infrastructure', 'policy', 'regulation', 'medical waste handlers', 'health risks', 'infectious disease', 'health complications', 'low and middle-income countries', 'developing countries' and 'resource-limited countries'. Along with these key concepts for search criteria, specific diseases (including COVID-19/coronavirus, HIV/AIDs, hepatitis B and C, cancer) and health complications (eg, respiratory disorders, cancer, burn and skin irritation) will be searched to find relevant articles.

Inclusion and exclusion criteria

Types of studies

All qualitative studies published in peer-reviewed journals (1) between 1 July 2011 and 30 June 2021 with full texts available and accessible will be included in the review. Qualitative literature will be chosen because the review's interest is to understand better the experiences of MWHs' health risks. Studies that (2) apply established qualitative data collection techniques (such as semistructured and unstructured interviews, focus group discussions, direct observations or semistructured questionnaires that permit free texts); (3) highlight the health risks experienced by MWHs; (4) focus on factors affecting MWHs' health risks in LMICs; and (5) are published in English will be included in the analysis.

Studies will be excluded if they (1) use statistical analysis and do not provide accounts/quotes of study participants, or (2) apply mixed methods which lack accounts or quotes of study participants, and (3) are study protocols, reviews, editorials, letters to editors, commentaries, conference abstract, posters and opinion pieces.

Participants/populations

Participants will include MWHs, defined as all workers (eg, waste cleaners, waste pickers, collectors, recycling waste operators, scavengers, landfill workers, garbage workers) who are directly involved in MW collection and final disposal at waste disposal sites (city corporation bins and general landfill sites), medical research institutes and healthcare facilities (public and private hospitals/clinics) as recommended by the WHO.[8] The participants will include: (1) MWHs of all age groups, including children from 10 years and above; (2) both male and female garbage workers; (3) waste pickers who search MWs before or after the final disposal; and (4) scavengers who search MWs before or after the final disposal. However, this review will exclude MWHs having severe pre-existing health risks before they became involved in MWM.

Type of setting

We will include studies from LMICs where MW workers are engaged in collecting MW from waste disposal sites, medical research institutes and healthcare facilities, and disposing of waste at disposal sites.

Table 1 The inclusion and exclusion criteria for this study

Items	Inclusion criteria	Exclusion criteria
Topics	Individual, system and policy-level factors affecting the health of MWHs in LMICs. Health risks experienced by MWHs.	Individual, system and policy-level factors affecting the health of medical waste handlers and health risks experienced by MWHs in upper middle and high-income countries.
Types of studies	Studies that apply semistructured and unstructured interviews, focus group discussions, direct observations or semistructured questionnaires which permit free texts.	Protocols, reviews, editorials, letters to editors, commentaries, conference abstract and posters, and opinion pieces. Studies that apply mixed methods which lack accounts or quotes of study participants or do not provide accounts/quotes of study participants.
Participants	(1) MWHs of all age groups, including children from 10 years and above; (2) both male and female garbage workers; (3) waste pickers who search medical waste before or after the final disposal; (4) scavengers who search medical wastes before or after the final disposal.	Children below 10 years of age. MWHs having severe pre-existing health risks before they became involved in MWM.
Settings	Waste disposal sites, medical research institutes and healthcare facilities, and disposal sites in LMICs.	Upper middle and high-income countries.
Date range	1 July 2011 to 30 June 2021	Published prior to July 2011.
Language	English	Excluded studies published in languages other than English.

LMIC, low and middle-income country; MWH, medical waste handler; MWM, medical waste management.

Table 1 summarises the inclusion and exclusion criteria for this systematic review.

Outcomes

This review's primary outcome will consist of the individual, system and policy-level MWM-related factors affecting MWHs' health in LMICs. The secondary outcome will be the health risks experienced by the MWHs in LMICs.

DATA COLLECTION AND ANALYSIS

Study selection

All studies identified in the search will be exported into the reference manager EndNote library. A three-step screening process will be applied to screen and select eligible studies. The first step will involve assessing the titles for relevance, in which case clearly irrelevant titles will be excluded. After that, abstract screening for eligibility and relevance will be conducted, and studies that do not meet the inclusion criteria will be excluded. In the final step, the full text of the retained studies will be further screened for inclusion in the review. Final studies selected from the full-text screening will be recorded. Two reviewers (MNH and TGH) will independently perform the study selection, and any disagreements will be resolved by a third reviewer (SH).

Data extraction and management

Data will be independently extracted by two review authors (MNH and TGH) from eligible studies onto the Joanna Briggs Institute standardised data extraction form for qualitative research[22] (see online supplemental file 3) and populated with variables pertaining to the study population and phenomena of interest. If there are disagreements between the two authors, a third author (SH) will double-check and verify the differences. Study characteristics that will be extracted will include the first author's name and publication year, data collection period and country in which the study was conducted. Then, descriptive data will be captured, including the study design, study population, sample size, sampling procedures and data collection procedures. The main findings and accounts of participants that explain the individual, system and policy-level MWM-related factors affecting MWHs' health in LMICs and the common health risks experienced by MWHs will be systematically extracted.

Quality appraisal

Studies included in this review will be assessed for methodological quality and risk of bias[23] using the Critical Appraisal Skills Programme (CASP) quality assessment tool for qualitative studies.[24] The CASP tool consists of 10 questions: 9 addressing 'quality' and 1 addressing 'value' (contribution to existing literature). All included studies will be appraised as high, medium or low quality, and the Grading of Recommendations Assessment, Development and Evaluation approach[25] will be used to assess the overall quality of the studies included in this review. Two reviewers (MNH and TGH) will independently score the quality appraisal assessment. We will apply both scoring methods and discussion to arrive at a consensus on quality. A third author (BA-I) will adjudicate should no agreement be reached between the two reviewers.

In line with other qualitative reviews,[26 27] this review will not exclude studies on the basis of quality. Instead, a further understanding of the contributions of the included studies will be provided at a later stage of this review. Regardless of the quality appraisal score, all studies relevant to the review questions will undergo data extraction and synthesis to assess and compare the findings. The results of the quality appraisal will be reported in a narrative form and a table.

DATA SYNTHESIS AND ANALYSIS

In accordance with the existing systematic reviews,[28 29] we will adopt the thematic framework analysis approach to identify the individual, system and policy-level MWM-related factors affecting MWHs' health in LMICs and their common health risks from the narratives of critical findings in selected studies.[30] The thematic framework analysis is one of the approaches recommended by the Cochrane Qualitative Review Methods Group[31] to perform syntheses of qualitative studies.[32] Thematic synthesis is appropriate where the evidence is likely to be mainly descriptive[28] and will enrich our understanding of the individual, system and policy-level MWM-related factors that can affect MWHs' health in LMICs and their experiences of health risks. We will follow the five stages of the thematic framework analysis to synthesise the data[28 33] (see below).

Familiarisation with the data

The first author (MNH) will begin with familiarising the data against the review aims and documenting recurrent themes across the studies.

Identifying a thematic framework

Given our interest in identifying a priori themes (individual, system and policy-level MWM-related factors affecting MWHs' health and their experiences of common health risks), we will use a predetermined thematic framework which was developed using literature (see online supplemental file 4) to guide the thematic analysis instead of developing our own a priori framework. We will also explore emergent issues (including author, country, research focus, etc) related to review objectives. This thematic framework provides a detailed list of individual, system and policy-level MWM-related factors affecting MWHs' health and their experiences of health risk in LMICs.

Coding

The two authors (MNH and TGH) will independently read the extracted information to search for themes according

to a predetermined thematic framework and additional emergent themes. The framework will be revised as new themes emerge. All studies will be read until there are no new emerging themes. The data will be coded based on the themes identified in the data. Each primary study will be indexed using the codes related to the themes of the framework. Where appropriate, parts of the studies may be indexed with one or more codes. All agreements and disparities between the coders will be resolved through discussion and consensus among all authors.

Charting

We will group the data into descriptive themes that capture and describe patterns in the data across studies and present the themes in the form of an analysis table (chart). The columns and rows of the table will reflect the studies and related themes and enable us to compare the findings of the studies across different themes and subthemes.

Mapping and interpretation

We will use charts to define the identified concepts and map the range and nature of the phenomena. This systematic review will explore relationships between the themes to help clarify the findings. We will synthesise the findings across studies and interpret their meanings concerning the review research questions and emerging themes.

Investigation of heterogeneity

We will assess heterogeneity of findings by conducting subgroup analyses according to: MWHs at various settings (healthcare facilities, incineration and waste disposal facilities, public and private healthcare facilities), ages (children vs adults), types of hazardous MWs (infectious, sharp, cytotoxic, radioactive, chemical and pharmaceutical) and health risks (infectious vs non-infectious). We will also consider other axes that can emerge as essential when synthesising the evidence, such as settings (low-income vs middle-income countries) and waste management in urban and rural areas.

DISCUSSION

Globally, most LMICs have inadequate and inappropriate MWM practices, and various factors contribute to exacerbating MWM-induced health risks among MWHs.[11 34] MWHs' vulnerability to health risks and the necessity for improving MWM in LMICs highlight a research and policy priority. A substantial pool of literature exists on the subject matter but remains undersynthesised. The considerable body of literature supports the necessity for a review to provide a robust summary of evidence that could be drawn on to optimise policies and planning related to MWM and health risks experienced by MWHs in LMICs. By analysing the accounts of participants across their exposure settings, and demography, this review could provide a direction where possible future interventions or research should focus on reducing the risks and long-term effects on MWHs. The results of this systematic review could be used to understand the individual, system and policy-level MWM-related factors affecting MWHs' health in LMICs and their experiences of common health risks. The review findings will inform and guide healthcare authorities in developing MWM-related interventions to improve MWHs' health in LMICs and reduce their health risks.

ETHICS AND DISSEMINATION

This review is based on published studies, which does not require ethical approval, because there is no collection of primary data. Findings from this review will be published in a reputable peer-reviewed journal and presented at a relevant public health conference. The protocol has been registered with the International Prospective Register of Systematic Reviews.

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Contributors MNH, SK and AF conceptualised the idea and designed the review. MNH, JSM, SK, SH and AF drafted the initial protocol. MNH and SK developed the search strategy. MNH interpreted, analysed and revised the manuscript with intellectual input from TGH, SZH, BA-I, RMI and AMNR. All authors read and approved the manuscript.

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

Patient consent for publication Not required.

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Additional file 1: PRISMA-P Statement—Checklist of items for qualitative studies

Items	Item numbers	Page numbers of manuscript
Title		
Identification	1a	1
Update	1b	N/A
Registration	2	2, 12
Authors		
Contact	3a	1
Contributions	3b	12
Amendments	4	N/A
Support		
Sources	5a	12
Sponsor	5b	12
Role of sponsor or funder	5c	12
Introduction		
Rationale	6	3-5
Objectives	7	2, 5-8
Methods		
Eligibility criteria	8	6-8
Information sources	9	1, 2, 5, 6, 12,
Search strategy	10	5-6
Study records		
Data management	11a	8-9
Selection process	11b	2, 8-10
Data collection process	11c	8-10
Data items	12	5-8, 12
Outcomes and prioritization	13	8
Risk of bias in individual studies	14	9
Data synthesis	15a-15d	9-11
Meta-biases	16	3, 6, 8
Confidence in cumulative evidence	17	9

Search strategy

Additional file 2: Search terms used in this systematic review.

#	Search terms
1	(“Medical waste” OR "infectious waste" OR "hazardous waste" OR "communicable waste" OR "contagious waste" OR "dangerous waste" OR “risky waste”, OR “unsafe waste” OR "transmittable waste” OR “epidemic waste” OR “spreading waste” OR “biomedical waste” OR “clinical waste” OR “biohazardous waste” OR “healthcare waste” OR “sharp waste*” OR “radioactive waste” OR “pathological waste *” OR “pharmaceutical waste” OR “laboratory waste” OR “chemical waste”).mp. [mp=Title, Abstract, Original Title, Name of Substance Word, Subject Heading Word, Keyword Heading Word, Protocol Supplementary Concept Word, Unique Identifier]
2	(“Manage* OR “disposal* OR “regulat*” OR “separate*”, OR “stor*”, OR “transport*” " intervention*” OR “process*" OR " handling*" OR " discharg*" OR “recycle*”).mp. [mp=Title, Abstract, Original Title, Name of Substance Word, Subject Heading Word, Keyword Heading Word, Protocol Supplementary Concept Word, Unique Identifier]
3	(Factor* OR determinant* OR issue* OR reason* OR cause* OR training OR knowledge OR infrastructure OR “technology provision” OR policy OR regulation).mp. [mp=Title, Abstract, Original Title, Name of Substance Word, Subject Heading Word, Keyword Heading Word, Protocol Supplementary Concept Word, Unique Identifier]
4	(Health OR “physical health” OR well-being OR wellness).mp. [mp=Title, Abstract, Original Title, Name of Substance Word, Subject Heading Word, Keyword Heading Word, Protocol Supplementary Concept Word, Unique Identifier]
5	(“Waste handler” "waste picker*" OR "garbage worker*" OR "rag picker*" OR scavenger*" OR " waste cleaner*" OR "landfill worker*" OR "informal worker*" OR "recycler*" OR "sanitation worker*" OR "trash collector*" OR “waste operat*” OR "sewerage worker*").mp. [mp=Title, Abstract, Original Title, Name of Substance Word, Subject Heading Word, Keyword Heading Word, Protocol Supplementary Concept Word, Unique Identifier]
6	(“Health risk*” OR “health effect*” OR “health complication*” OR “communicable disease*” OR “infectious disease*” OR “contagious disease*” OR “contagious illness*” OR “transmissible disease” OR “physical risk” OR “respiratory disorder*” OR “liver disease” OR COVID-19 OR coronavirus OR cancer OR HIV OR AIDS OR hepatitis OR typhoid OR

	burn OR irritation, OR injury).mp. [mp=Title, Abstract, Original Title, Name of Substance Word, Subject Heading Word, Keyword Heading Word, Protocol Supplementary Concept Word, Unique Identifier]
7	(“Low-income countr*” OR “middle-income countr*” OR “low and middle-income countr*” OR “resource-constrained countr*" “resource-limited countr*” OR “developing countr*" OR “marginalised countr*" OR “underprivileged countr*” “poor countr” OR “unindustrialised countr*” OR “emerging countr**” OR “less developed countr*” OR “underdeveloped countr*”).mp. [mp=Title, Abstract, Original Title, Name of Substance Word, Subject Heading Word, Keyword Heading Word, Protocol Supplementary Concept Word, Unique Identifier]
8	#1 AND #2 AND #3 AND #4 AND #5 AND #7 Filters: Full text; English, NOT systematic review, NOT quantitative studies.
9	#1 AND #5 AND #6 AND #7 Filters: Full text; English, NOT systematic review, NOT quantitative studies.

Additional file 3: JBI data extraction tool

JBI QARI Data Extraction Tool for Qualitative Research

Reviewer _____ Date _____

Author _____ Year _____

Journal _____ Record Number _____

Study Description

Methodology

Method

Phenomena of interest

Setting

Geographical

Cultural

Participants

Data analysis

Authors conclusions

Comments

Complete Yes ☐ No ☐

Findings	Illustration form Publication (page number)	Evidence		
		Unequivocal	Credible	Unsupported

Extraction of findings complete Yes ☐ No ☐

Additional file 4: Thematic framework analysis format for summarizing the individual, system, and policy-levels factors influencing the health of medical waste handlers (MWH) in LMICs and their health risks experience.

Main themes	**Emerging sub-themes**	**Quotes**	**Studies (Author/year)**
Factors influencing the health of medical waste handlers	Individual level		
	System level		
	Environmental level Policy level		
Health risks experienced by MWH			
Any emerging themes			