



Review

A systematic review on the management and treatment of mercury in artisanal gold mining

Tara Rava Zolnikov ^{a,*}, Daisy Ramirez Ortiz ^{b,1}^a Department of Community Health, National University, 3678 Aero Court, San Diego, CA 92123, United States^b Florida International University, Department of Epidemiology, 11200 SW 8 ST. AHC5 Room 490, Miami, FL 33199, United States

HIGHLIGHTS

- Many interventions try to remove mercury in artisanal gold mining.
- This review found social, technical, environmental aspects must be considered.
- A systematic review determined barriers involved with current solutions.
- Removing mercury in AGM requires a comprehensive approach.
- Technology, education, mineralogy, and government support are needed.

GRAPHICAL ABSTRACT

Solutions addressing mercury in artisanal gold mining must be comprehensive.



ARTICLE INFO

Article history:

Received 2 January 2018

Received in revised form 20 March 2018

Accepted 20 March 2018

Available online xxx

Editor: Mae Sexauer Gustin

Keywords:

Systematic review

Worldwide

AGM

SAGM

ASM

Solutions

ABSTRACT

Artisanal gold mining (AGM) continues to be a pervasive global health issue. While there are various problems associated with AGM, mercury exposure is the primary hazard contributing to adverse health effects in exposed human populations. Over the last several decades, many interventions have been developed and implemented to curb mercury emissions and releases, notwithstanding a comprehensive review of context specific effectiveness. A systematic review was conducted in order to specifically assess the impact of current mercury interventions within the AGM sector worldwide. To aid in this review, a resource pool of information on AGM and mercury, treatment and management of emissions and releases, and interventions was assembled through a search conducted via multiple search engines. This search determined that there have been many strategies used to reduce or eliminate mercury, through interventions or programs focusing on education, processing centers, or mercury alternative techniques. Education has focused on environment or health awareness or more specifically on cleaner or alternative techniques. Processing centers offered artisanal miners rudimentary equipment for grinding and amalgamation that extract less than 30% of the gold as an exchange for their tailings. Some techniques reduced mercury releases including retorts, mill leaching, vat-leaching, and others replaced mercury from the process such as magnets, direct smelting, sluices, and borax. There are both positive and negative outcomes associated with every intervention. Novel and comprehensive strategies—including mercury removal technology, miner education on mercury hazards, economic gains, and policy—are needed to address mercury public health issues associated with AGM.

© 2018 Elsevier B.V. All rights reserved.

* Corresponding author.

E-mail address: tarazolnikov@gmail.com (T.R. Zolnikov).¹ Both authors contributed equally to this manuscript.

Contents

1. Introduction	817
2. Methods	817
2.1. Limitations	818
3. Results	818
3.1. Educational interventions.	818
3.2. Processing centers	820
3.3. Techniques to reduce mercury releases.	820
3.4. Alternative techniques to mercury amalgamation	820
4. Discussion	821
4.1. Complexity of interventions.	821
4.2. Economic gains	821
4.3. Mineralogy	822
4.4. Social aspects	822
4.5. Improvements	822
5. Conclusion	823
Acknowledgements	823
References	823

1. Introduction

Artisanal gold mining (AGM) is an extractive sector that has managed to not only maintain its presence across decades but has also grown. This situation has occurred for a variety of reasons: 1. mining can occur independently; 2. the unfaltering market value of gold; and 3. ease and accessibility of technology applied. AGM has evaded cultural differences and is a viable resource worldwide. In fact, the combination of these factors has contributed to the widespread adoption and use of AGM. There are approximately 50 million people involved in the sector in approximately 70 different countries (Telmer and Veiga, 2009; Veiga and Baker, 2004).

The main problem with this type of mining is that miners use mercury to extract gold from ore. Amalgamation by mercury is an inexpensive, easily accessible, and uncomplicated procedure that extracts an adequate amount of gold from ore, thereby economically sustaining the lives of participants (Spiegel et al., 2006). Unfortunately, AGM has numerous problems associated with it that directly stem from mercury use through emissions and exposures. Both human health and environmental ramifications exist from mercury use. The environment is affected through high levels of river siltation and mercury pollution in sediment and soil (Lebel et al., 1995, 1998; Taylor et al., 2005; Babut et al., 2003). On the other hand, exposed human populations can suffer from chronic or acute exposure to mercury, which may result in dose-dependent adverse health effects. Acute, low-dose exposure to mercury can lead to respiratory symptoms such as chest pains, dyspnea, cough, hemoptysis, impairment of pulmonary function, and interstitial pneumonitis; while acute, high-dose exposure can be fatal or lead to permanent damage within the central nervous system (EPA, 2011; Poulin et al., 2008). Perhaps more common in AGM are chronic, low to moderate-dose exposure levels, which are characterized by less pronounced symptoms such as fatigue, irritability, loss of memory, vivid dreams, and depression (EPA, 2011). These varying degrees of adverse health effects provide evidence to the toxic nature of mercury exposure, in general, and specifically in the field of AGM.

Millions of dollars have been spent on sector-specific policies and regulations for decreasing mercury emissions (Hilson, 2008). In 2007, most of this funding (e.g. from United Nations, The World Bank, Global Environmental Facility, German Technical Cooperation Agency, and GiZ) had failed to facilitate marked improvements regulating mercury and miners continue to be exposed to potentially hazardous levels of mercury (Hilson, 2008). Since then, it is likely that additional interventions have attempted to decrease and eliminate mercury emissions; however, information on the effectiveness of recent efforts have not been reviewed in its entirety and disseminated. One study (see Davies, 2014) reviewed alternative solutions to mercury removal in

AGM, although this review did not follow a rigorous search of the literature (e.g. only included a few studies, information was dated beyond the current scope of knowledge, etc.). Therefore, the state of research regarding attempted or potential solutions addressing mercury in AGM continues to be ill-defined (Hilson, 2009). Thus, the goal of this review was to comprehensively evaluate current efforts aimed at managing and treating mercury emissions or releases in AGM. These interventions were then analyzed in order to understand economic and context-specific dimensions pertaining to each effort, and to understand the sustainability and transferability of each intervention from a worldwide perspective.

2. Methods

A search was conducted and included relevant published scientific literature using ProQuest, JSTOR, Springer Link, ScienceDirect, and Sage Journals website. The search was designed to identify any studies on the management or interventions developed to address mercury emissions within the AGM sector. Search terms included: “small mining” or “small scale mining” or “small artisanal gold mining” or “artisanal mining” or “artisanal gold mining” or “mercury” or “alternative” or “alternatives” or “solution” or “solutions”. The search was date restricted to gather articles from January 2007 to December 2017, in order to retain current data—or within the last ten years. The search was not restricted by language. References cited in identified articles were also reviewed. Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines were used for reporting the search and selection of results. All references were imported into an EndNote Library and duplicates were removed manually within EndNote leaving a total of 5492 results (5482 from electronic databases and 10 from hand-searching). A two-stage screening method was conducted, where titles alone were screened first, followed by screening of titles and abstracts of those not rejected in the first stage (Mateen et al., 2013). The researchers then reviewed the full-text of articles uncovered by the search. Any discrepancies were resolved through discussion until consensus was reached. The criteria for studies included any intervention or program that ultimately sought to curb mercury emissions and releases. Some studies were theoretical or lab-based, but those were included as well, as long as they were specific to AGM. Gathered information for each study included the reference and year of publication, location of the intervention, type of intervention, purpose of the study and brief description on the results. The brief description was used to describe how the intervention worked, the benefits of it, and the negative aspects. Gold extraction gains and emissions reduction were also included to enhance the cost-benefit associated with the intervention. The expectation was that the culmination of these factors would

Download English Version:

<https://daneshyari.com/en/article/8860227>

Download Persian Version:

<https://daneshyari.com/article/8860227>

[Daneshyari.com](https://daneshyari.com)