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Petroleum pipeline explosions in sub-Saharan Africa: A comprehensive systematic review of the academic and lay literature

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ABSTRACT

Background: Experience indicates that the frequency and impact of petroleum pipeline fires and explosions in sub-Saharan Africa (SSA) is presently under-represented in the academic literature.

Materials and methods: Using adapted PRISMA guidelines, the authors reviewed both PubMed and the LexisNexis Academic news database, which includes periodicals, news transcripts and online reports. Country-by-country searches were conducted for petroleum pipeline fires and explosions in SSA occurring between June 1, 2004 and May 31, 2014.

Results: Initial search yielded 5730 articles from LexisNexis Academic and 3 from PubMed. On further review, a total of 28 separate petroleum pipeline-related incidents causing injuries and/or deaths were identified, 16 of which had not been previously reported in the academic literature. The events occurred in Nigeria (23), Kenya (2), Ghana (1), Sierra Leone (1), and Tanzania (1). A total of 1756 deaths were reported across all events. The most common cause of the original leak was intentional, either from theft or vandalism (13/20, 65%), or by militia activity (2/20, 10%).

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Abbreviations: SSA, sub-Saharan Africa.

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Conclusions: Fire disasters related to scavenging fuel from petroleum pipelines are common in SSA and cause significant morbidity and mortality. These events require better reporting tools and intervention strategies overall. Furthermore, our study demonstrates that non-academic sources can effectively supplement gaps in the academic literature.

1. Introduction

Africa produces more than 12% of the world's petroleum products and is estimated to hold nearly 10% of all oil reserves [1]. Oil infrastructure and pipeline networks have rapidly expanded throughout the continent in recent decades [2]. Fuel pipelines may present considerable risk for explosions and fire disasters and frequently result in high numbers of severe burns, blast injuries, and deaths [3].

Although pipeline-related incidents can occur in any country that extracts or transports petroleum, these events are particularly concerning in sub-Saharan Africa (SSA), where the practice of ''scooping'', or scavenging fuel leaking from damaged pipelines, is relatively common [3]. Pipelines that are damaged either naturally or purposefully become extremely vulnerable to fires and explosions. These events can be caused by the method of disrupting the pipeline (e.g. gunfire or dynamite) or merely a cigarette. For example, one such incident in Nigeria in 1998 claimed 1082 lives after a vandalized pipeline caught fire and exploded [4]. The event also caused innumerable injuries, resulting in prolonged hospitalizations and a high rate of severe morbidity [4].

To more effectively characterize the incidence and burden of these events, the authors conducted a comprehensive systematic review incorporating both the academic and lay literature, including periodicals, news transcripts and online reports.

2. Materials and methods

The authors utilized an approach adapted from the PRISMA guidelines for systematic reviews to evaluate both the academic and lay literature [5]. Primary searches were conducted of PubMed, to review the academic literature, and the LexisNexis Academic news database, to review non-academic sources. LexisNexis Academic houses a comprehensive news database comprised of full-text documents from more than 3000 newspaper publications from around the world, non-English language news sources, broadcast transcripts from the major television and radio networks, and wire services, including respected sources such as the Associated Press, Business Wire and PR Newswire [6]. The primary LexisNexis Academic search included the content categories: News transcripts, Magazines and journals, Industry trade press, News, Newswires & press releases, and Web-based publications.

In order to locate all applicable reports of fuel pipeline-related incidents resulting in injuries or deaths, the following Boolean search terms for both PubMed and LexisNexis Academic were selected: ''*country-name* AND *pipeline* AND (*explosion* OR *blast* OR *fire*) AND (*death* OR *killed* OR *injured* OR *injury* OR *mortality*)''. The authors conducted searches in a country-by-country fashion for each country in SSA as specified by the World Bank [7]. This was done in order to avoid search return caps limiting the number of results reported by the LexisNexis Academic search engine. The authors also intentionally excluded terms such as ''fuel'', ''petroleum'', and ''oil'' from the search in order to maintain a broad scope. The search was narrowed to the last ten years, June 1, 2004–May 31, 2014. Therefore, only news articles in LexisNexis Academic from this time period were reviewed. Reviewers retrieved all articles identified though PubMed, regardless of publication date; however, only information related to events occurring within this timespan was extracted. The primary searches were also supplemented with similar yet informal searches of BBC News archive, Al Jazeera online, and Google to support findings and to ensure that all potential events reported throughout the lay literature were included.

A single reviewer conducted the initial review. All papers located in the PubMed search were reviewed in full for information related to pipeline fire disasters and explosions. The reviewer evaluated all news headlines and article titles located through the LexisNexis Academic search for relevance and then scanned articles for keywords including ''pipeline'' and country-name. Inclusion criteria included: the article being published in English or being pre-translated by LexisNexis; the article explicitly reporting a pipeline fire or explosion; the article specifying the date of the event; and the article quantitatively or qualitatively reporting deaths and/or injuries associated with the event. Results were sorted by date and the reviewer tallied the number of articles from LexisNexis Academic reporting each incident. Duplicate articles within each search, being those published with the same headline, date, and publisher, were excluded in the tallied results.

Information regarding all reported pipeline fires and explosions, specifically the date of the event, nature of the incident, and the number of associated deaths and injuries, was extracted from both academic and lay sources. When the number of injuries or deaths secondary to a reported event varied between reports, the reviewer recorded these values as the range. If different sources reported multiple dates for a single event, the earliest date reported was used. This data was then tabulated and further analyzed using basic statistical functions in Microsoft Excel (2010).

3. Results

Initial search yielded 5730 articles from LexisNexis Academic, and 3 from PubMed (see Table 1). After review, a total of 378