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What will go wrong has gone wrong- Asbestos exposure risk among construction workers in Nigeria --Manuscript Draft--

Full Title:	What will go wrong has gone wrong- Asbestos exposure risk among construction workers in Nigeria
Manuscript Number:	TPHS-2018-0005R2
Article Type:	Review Article
Keywords:	asbestos; chrysotile; occupational exposure; construction industry; nigeria
Abstract:	<p>Asbestos is a naturally occurring silicate with six varieties from two groups of minerals serpentine (chrysotile) and five amphiboles (amosite, crocidolite, tremolite, anthrophyllite and actinolite) with chrysotile widely used form. Asbestos containing materials (ACM) use in Nigeria from 1970 to 2000 was 1,091,370 tons. Its demand peak coincided with landmark edifices construction in the country that include FESTAC Village and the National Theatre Iganmu. The inward low cost housing construction investment policy in urban areas in the 1970-80s ensured demand for ACM was consistent. Given the widespread use of ACM and non-availability of national data on workers exposure, the problem posed is unlimited. Poor implementation of asbestos regulation and industry codes of practices contributed to inadequate risk management regime. Desktop survey on ACM demand revealed the product continual use, but goes unreported. Low cost of ACMs and the absence of strong regulation to enforce a ban in the industry are critical factors in their proliferation. Lack of official record for asbestos mortality or morbidity rates and the nonexistence of reliable mechanism to enforce its ban present serious health risk among construction workers. This call for national asbestos exposure survey to ascertain the extent of the problem within the construction industry.</p>
Order of Authors:	Haruna Musa Moda Henry Sawyerr Anne Clayson
Response to Reviewers:	<p>Paper changes based on reviewers comments received:</p> <ol style="list-style-type: none">1.Abstract: Further improvement has been done. Asbestos types now included and potential scale of the problem in Nigeria emphasised2.Introduction (Page 3 comments)<ol style="list-style-type: none">a.Line 10: Clarity has now been provided and both sentences mergedb.Line 47: Typo now amendedc.Line 51: Insulation has now been added3.Introduction (page 4 comments)<ol style="list-style-type: none">a.Line 2: More clarity has now been provided to the earlier statement made taking on board the comments/suggested improvementb. Line 30: Grammatical error corrected4.Introduction (page 5)<ol style="list-style-type: none">a.Line 16: Distinction now made between varied form asbestos related effectsb.Line 26: Discussion around asbestos fibre has been addedc.Line 47: ILO stand on asbestos exposure added5.Introduction (page 6)<ol style="list-style-type: none">a.Line 5: Canadian chrysotile production and controversy of the process has been included6.Asbestos use in Nigeria (page 7)<ol style="list-style-type: none">a.Line 7: There is paucity of data on the subject in Nigeria. However, one study reporting misdiagnosis of Mesothelioma for tuberculosis has been added to support the gapb.Line 20: Estimate has now been provided7.Asbestos use in Nigeria (page (page 8)<ol style="list-style-type: none">a.Line 5: Evidence provided to support the claimb.Line 24: Typo amendedc.Line 30: Typo amended8.Asbestos exposure among construction worker in the country (Page 9)

a.Line 22: Typo amended
b.Line 43: Concern raised has now been addressed and estimate of potential burden strengthen
c.Line 58: Projected asbestos related cancer cases has now been included
9.Asbestos exposure among construction worker in the country (page 10)
a.Line 21: Grammar concern has now been improved
10.Asbestos exposure among construction worker in the country (page 11)
a.Line 26: Earlier statement made has been improved based on the concern raised
11.Conclusion (page 14)
a.Line 21: Conclusion now reduced under 400 words

Table 1: Predicted 15 year cumulative mortality arising from mesothelioma (1994-2008) in African countries using asbestos but not reporting mesothelioma frequency

Country	Cumulative use of asbestos (tons), 1920–1970	Predicted cumulative mortality (n)	95% CI
Zimbabwe	122,595	447	323-617
Algeria	90,005	337	238-477
Swaziland	87,868	329	232-468
Morocco	55,697	217	147-321
Nigeria	34,443	140	91-216
Democratic Republic Of Congo	22,579	95	59-153
Uganda	18,139	78	47-128
Zambia	15,607	68	41-113
Mozambique	14,566	64	38-107
Angola	14,378	63	37-106
Tunisia	9,724	44	25-77
Kenya	3,153	16	8-31
Botswana	1,163	6	3-14
Senegal	799	5	2-10
Libya	540	3	1-7

Adapted from Park et al. 2011

Table 2: Common asbestos products and their use in typical buildings with asbestos in Nigeria

Product	Use in building*
Roofing sheet (flat or corrugated)	Roofing, wall cladding and water gutters
Textured/stipple coated ceiling	Ceilings, facades, partitions
Asbestos-Cement Pipe	Delivery of portable water and drainage system
Window putty	Window and door glass sealant
Stucco	Coating of wall/ceiling surfaces and architectural decorations
Vinyl tiles, linoleum flooring sheet etc.	Flooring of indoor space
Flooring adhesives	Laminating floor materials
Toilet pipe lagging	Drainage work
Cement panel	Roofing panel

*Information in the table was compiled based on internet search around asbestos product use in Nigeria.

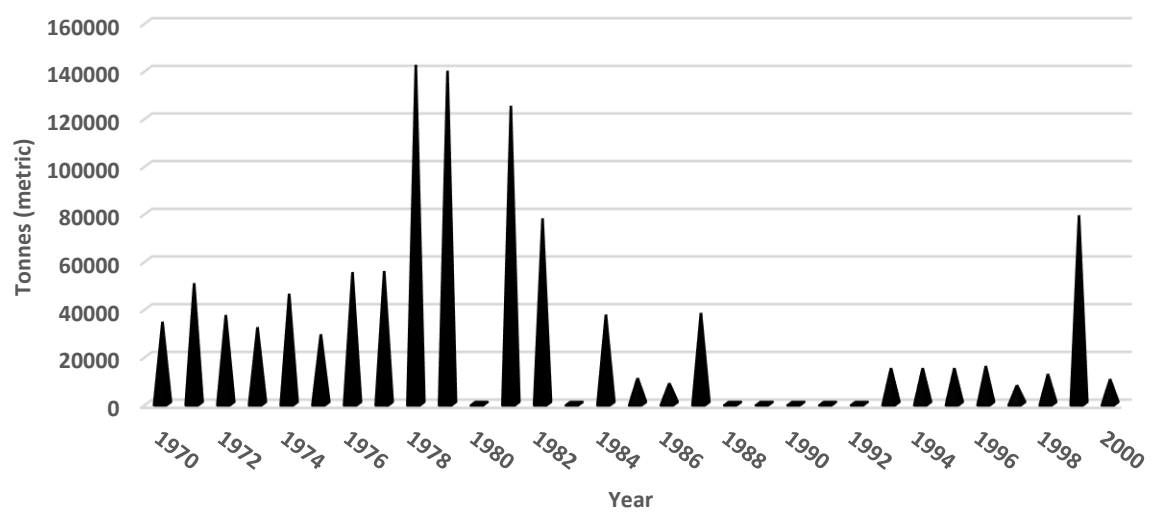


Figure 1: Nigeria annual global asbestos import (1970-2000) (source- British Geological Survey)

1. Introduction

1 The public health significance of asbestos cannot be understated. Originating from ancient
2 Greek terminology, its derivation is “inextinguishable, unquenchable or inconsumable”.
3 Asbestos has notorious characteristics as a fibrous, solid, chemically non-reactive carcinogen.
4 It is a naturally occurring silicate with six varieties from two groups of minerals, namely the
5 serpentine (chrysotile) and the five amphiboles (amosite, crocidolite, tremolite,
6 anthrophyllite and actinolite). Because of its fibrous and crystalline characteristics, the
7 product was successfully commercialised in the Industrial age, and extensively used in the
8 20th Century. Findings revealed that 95% of world asbestos production has been chrysotile
9 (white asbestos) and is the most widely used form of asbestos (Kanarek, 2011, Ruff, 2017)
10 and this paper focuses on the use and exposure of white asbestos (chrysotile) in Nigeria.

11 Historically, asbestos has been used in a diverse range of human activities, which include
12 paintings, ceramic and pot making, lamp wicks, cigarette filters, brake pads and other ancient
13 artefacts with evidence suggestive of ancient Egyptian use as clothing to preserve the bodies
14 of dead pharaohs (Marioryad et al. 2011, Kratzke and Kratzke, 2018). In addition to its use,
15 both ancient and contemporary, the issues around disposal, and its continued and often
16 unregulated use mean it is environmentally ubiquitous (Virta, 2006, IARC, 2012). Its high
17 tensile strength, flexibility, resistance to chemical and thermal degradation, high electrical
18 resistance, low electrical conductivity, and large surface area characteristics make it a cost-
19 effective and commercially viable building material. These qualities have informed the
20 product high demand in construction industries globally in the 20th Century and continue to
21 do so, especially in developing countries (Joshi and Gupta, 2004, Virta, 2006, Marioryad et al.
22 2011). In addition, its unique characteristics makes it a highly desirable material in several
23 applications that include, car break liners, gaskets, insulation and packing materials in
24 industrial and maritime settings, such as refineries, chemical plants, naval ships, and energy
25 plants (Joshi and Gupta, 2004, Marioryad et al. 2011, Madl et al. 2014, WHO, 2015). However,
26 its shape and size plays a crucial role in the incidence of asbestos exposure-related chronic
27 diseases. The evidence for asbestos exposure-related chronic morbidity and high mortality
28 has resulted in global awareness and campaigns to ban its use, with strict measures
29 implemented in many nations aimed at reducing asbestos exposure. In high-income
30 countries, this has led to a gradual decline in the number of new cases of cancers linked to
31 environmental and occupational asbestos exposure. Conversely, currently undiagnosed cases
32 from historical exposure are a concern, with recent reports in the UK postulating that despite
33 rigorous control measures taken, the number of mesothelioma cases in the UK, especially
34 among males would continue to rise, peaking in 2038, after which exposure related deaths
35 would decline leaving only “background cases” (Tan and Warren, 2009). Background cases
36 would result from historical exposure and the number of new cases of asbestos related
37 exposure should in practice be eliminated. However, based upon current practice and
38 regulatory frameworks in Nigeria, there is a high likelihood of a climbing incidence and
39 prevalence of mesothelioma and other asbestos related conditions within the population.
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1 An Asbestos ban in the European Union came into force on the 1st January 2005, in response
2 to the persistent chronic asbestos-related disease. Projection of approximately 500,000
3 deaths caused by asbestos-related diseases are likely to be realised in Western Europe by
4 2030 (Vogel, 2005). In 2008, South Africa announced a ban on the use, manufacturing, import
5 and export of asbestos and asbestos containing materials. Prior to the introduction of the
6 ban, the country has a high case incidence of Asbestos related diseases during the year 1995
7 to 2007 with reported mortality of 2,509 total mesothelioma deaths (Franz, 2013). The lack
8 of public health awareness campaigns by governments and other key stakeholders
9 compounds a high likelihood of continued and more worryingly, increased exposure and
10 subsequent diagnosis of chronic disease due to industrialisation and economic growth and
11 expansion. This is a replication of high-income country experience throughout much of the
12 last century (Lee et al. 2013, Hashim and Boffetta, 2014). The continued use of asbestos in
13 developing has largely been encouraged by competing national developmental priorities,
14 which now require urgent attention by nations where asbestos use is largely uncontrolled.
15 Since the 1900's, certain diseases have typically been associated with asbestos exposure
16 (Boffetta, 2007, Bunderson-Schelvan et al. 2011). However, with the ban of the product in
17 high-income countries in the late 20th Century this has resulted in marketing of the product
18 to less developed, lower and middle-income countries, considered as having a weak
19 regulatory approach toward the product ban implementation. As reported by Marsili et al.
20 (2016) "suspicions that lung cancer may be associated with asbestos exposure were first
21 reported in the USA and the UK in the 1930s, and decades later reports of pleural tumours
22 associated with asbestos exposure followed". Several articles have reported on the
23 association between asbestos fibre exposure to several forms of ill health that include
24 pulmonary fibrosis, chronic obstructive pulmonary disease, pleural plaques, pleural effusion,
25 pulmonary fibrosis (asbestosis), lung cancer, and mesothelioma of the pleura or peritoneum
26 in humans (Harrington and McGlashan, 1998, Joshi and Gupta, 2004, Braun and Kisting 2006,
27 Tan and Warren, 2009, Bunderson-Schelvan et al. 2011, Lee et al. 2013, Hashim and Boffetta,
28 2014, WHO, 2014, WHO, 2015, Nynäs et al. 2016, Kratzke and Kratzke, 2018). Its exposure
29 primarily occurs because of inhalation in the immediate environment and from ambient air
30 near point sources. Exposure can occur in occupational settings either from dry cutting of
31 asbestos containing products, repackaging of asbestos materials, exposure to physically
32 damaged asbestos-containing products, clearing of debris, disposal and management of sites
33 where asbestos is contained. Globally around 125 million individuals are estimated to be
34 exposed to asbestos due to workplace exposure alone, with around 100, 000 yearly mortality
35 from asbestos related disease (Joshi and Gupta, 2004; Braun and Kisting 2006, WHO, 2012,
36 Lee et al. 2013, WHO, 2014). Given the regulatory environments in middle income countries
37 (MIC) and low income countries (LIC), the absence of precautionary principle approaches and
38 the lack of data on current mortality and morbidity, it can be reasonably argued that exposure
39 cases and the resultant mortality goes unreported in these countries due to poor diagnosis,
40 lack of knowledge and understanding and adhoc medical records management. Notably,
41 Nigeria is not an exception and as a result of paucity of national data, It was not possible to
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1 determine mortality incidence by asbestos types, however, it is on record that factories
2 which were operational in Nigeria during the asbestos “boom” era were involved in the
3 production of white asbestos materials (Eton, 2006, Sarauta and Bala 2014).

4 The International Agency for Research on Cancer (IARC) in 1973 categorised asbestos as a
5 human carcinogen and 44 years later, WHO (2014) further confirms the relationship between
6 exposure to either forms of asbestos -chrysotile, amosite and anthrophyllite or their mixture
7 and the increased risk of lung cancer and mesothelioma among workers and those living
8 around asbestos factories and mines, as well as among individuals living with asbestos
9 workers. To date, countless studies into occupational and non-occupational exposure to
10 asbestos have demonstrated strong links to asbestosis, mesothelioma and pulmonary disease
11 and other diseases (Joshi and Gupta, 2004; Braun and Kisting 2006, WHO, 2012, Lee et al.
12 2013, WHO, 2014; Marsili et al. 2016). In considering the extensive epidemiological evidence
13 of asbestos as a human carcinogen, over 50 countries have so far banned asbestos production
14 and use, while several nations have applied strict restrictions on its use. Despite the
15 widespread ban, there is still a market for mining, production, import and export of asbestos
16 and associated products particularly in developing countries (Harington, and McGlashan,
17 1998, Takahashi and Kang, 2010). Lack of adequate measures to monitor the use of asbestos
18 products by governments in these countries is seen as major shortfall that will lead to both
19 the continuous exposure of workers to asbestos fibres and the extremely high risk to the
20 health of these workers and their families. Considering this shortfall, International Labour
21 Organisation (ILO) and WHO (2007), called for the adoption of a programme to eliminate
22 asbestos related diseases among nations. This comprises the development of strategic policy
23 within the national profile of health protection; awareness raising; capacity building;
24 development of institutional frameworks and the adoption of a national plan of action for the
25 elimination of asbestos-related diseases. Much is left to be seen in this area in Nigeria, due to
26 the lack of adequate coordination of health improvement and disease prevention
27 programmes, coupled with bureaucratic bottlenecks where major stakeholders tend to work
28 in “silo” which hinders meaningful co-operation. Occupations that are at most at risk of
29 asbestos fibre exposure and asbestos associated diseases range from construction work, the
30 repairing, remodelling or demolition of buildings, service and maintenance work in buildings
31 containing damaged asbestos-containing materials, and production of some auto parts,
32 especially the making of brake and clutch pads (Erdoğan et al. 2003). Where asbestos exposure
33 remains, due to primary production or secondary use of its products, such as in South Africa,
34 Zimbabwe, Nigeria, Brazil, Russian Federation and China, an estimated 1 million workers are
35 said to be at high risk of developing mesothelioma (Joshi and Gupta, 2004, Braun and Kisting,
36 2006, Hashim and Boffetta, 2014, Marsili et al. 2016), thereby creating a high-risk “incubator”
37 of asbestos related diseases (Lee et al. 2013). Thus, the burden of asbestos related disease in
38 developing countries remains largely unknown (Boffetta, 2007, Bunderson-Schelvan et al.
39 2011). This is in part was compounded by the role played by developed countries in the
40 marketing of these products up to the start of the 21st century. Canada until recently was a
41 major producer and exporter of chrysotile asbestos where majority of the country’s
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1 production was exported to developing countries where little or no protection exists for
2 workers or exposed populations. The Rotterdam Convention meeting held in Geneva 2011
3 saw Canadian delegation disapproval for the addition of chrysotile asbestos fibre to
4 Convention to the surprise of other stakeholders. This was a further demonstration of the
5 roles played by the country in the marketing of these products to developing countries at the
6 detriment of the health of the workers and the public at large. While this was on going, the
7 Canadian government were actively removing ACMs from all its public buildings and has
8 placed ban on using the substance in any form. Despite these local efforts made at removing
9 the product from circulation, the export trend continued due to the climate of silence evident
10 from industrial partners within the country (Kirby, 2010, Kanarek, 2011, Frank and Joshi, 2014,
11 Ruff, 2017).

12 Historical records indicate the global use of asbestos from 1920 to 2003 was around 180
13 million metric tons, with white asbestos (chrysotile) the commonest asbestos type utilised
14 especially in the construction industry (Lee et al., 2013). Furthermore, Lin et al. (2007)
15 estimates between 20–40% of global adult men might have held jobs that could have exposed
16 them to asbestos dust. However, there are little or no records of asbestos exposure hazards
17 documented in several developing countries including Nigeria. Despite the lack of
18 epidemiological data in these countries, asbestos hazards and exposure, asbestos related
19 disease and associated prognosis are issues that cannot be ignored because of the long
20 latency periods following exposure that historically have masked the extent of occupational
21 and paraoccupational illnesses associated with asbestos exposures. In most cases workers in
22 these countries are more often than not engaged in asbestos risk reduction decision-making,
23 and with high level of unemployment, it is very much easy to find willing individuals to take
24 on any construction job irrespective of the hazard involved (Levy and Seplow, 1992).
25 Generally, the nature of the construction industry in most developing countries, where it is
26 not fully regulated is seen as a precursor to the “silence” on asbestos surveying in such
27 countries. Addressing this illness prevention gap will contribute to the development of a
28 comprehensive understanding of asbestos exposure and inform the development of
29 strategies required to improve occupational safety, and minimise environmental exposure to
30 optimise the health protection for all stakeholders.

31 **2. Asbestos use-the Nigeria context**

32 Up to this present moment, Nigeria have not introduced a ban on asbestos use and is also not
33 listed on the International ban asbestos secretariat (IBAS) to have done so. Despite the lack
34 of data on asbestos restrictions, there is no official record in Nigeria with respect to the
35 occupational exposure of asbestos and subsequent development of asbestos related disease.
36 This is now a matter of urgency as emphasised in this paper, and all stakeholders concerned
37 should consider asbestos control and ban. The composition of asbestos types that has been
38 used in Nigeria construction industry is unclear, however, in the 1970’s, Chrysotile was the
39 most commonly used building material in Nigeria (Ogu and Ogbuozobe, 2011, WHO, 2014)
40 because of its unique characteristics. Park et al. (2011) estimated the country’s cumulative
41 use of asbestos (in tons) from 1920 to 1970 was 34,443 tons and a predicted cumulative
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1 mortality of 140 with 95% CI 91-216 (Table 1). Its use in the country quickly increased after
2 these years and data available from the British Geological Survey (BGS, 2017) showed
3 Nigeria's global asbestos import volumes of 1,091,370 tonnes from 1970-2000 and peaked in
4 1978 with 142,242 tonnes imported into the country (figure1). Historically, asbestos-
5 containing materials (ACM) has been used commercially in Nigeria as roof and wall claddings
6 as well as decorative and acoustic applications, water and drainage pipes, electrical
7 switchboards, insulators and fittings, vinyl floor coverings, asbestos felts and paper-like
8 products. Other application include friction materials such brake linings, paints, coatings,
9 sealants and adhesives, packings and gaskets (Ogu and Ogbuozobe, 2011, Idris et al. 2015,
10 Yawas et al. 2016).

11 The peak of asbestos use in the nation construction industry was in 1970s which coincided
12 with the construction of landmark edifices in Lagos State (the former capital city of Nigeria)
13 such as the FESTAC Village with around 500 residential dwellings, the National Theatre
14 Iganmu as well as other construction works around the entire country (Uzoma, 2013). In
15 addition, the second republic government drive around the construction of low cost mass
16 housing estates in every state of the federation saw a high consumption of the products in
17 the country. Although little has been said of asbestos production in Nigeria, previous reports
18 by Eton (2006) and Sarauta, and Bala (2014) revealed that up to 1996 asbestos cement and
19 other products were manufactured locally as a joint ventures in remote settlements that
20 include Bigi in Bauchi town. In addition, the UNDP (2006) report further contain evidence of
21 asbestos production in other cities within Nigeria that include Kano, Lagos, Delta, Edo and
22 Rivers. Evidence suggests the products are still in demand and use (Table 2) in the
23 construction industry and in most cases, it goes unreported to relevant authorities (Vogel,
24 2005, UNDP, 2006). Further, during a two-day national stakeholders training workshop in
25 2015 organised by the Federal Ministry of Environment in collaboration with the World Bank,
26 the United Nations representative called upon the country's government to ban the
27 importation of asbestos into Nigeria (PM News, 2015), this statement is a further
28 demonstration of the existence of ACM especially in the construction industry. The primary
29 factor for the continuous use of asbestos products in the country is its low cost compared to
30 other substitutes readily available and the absence of any strong regulation to enforce the
31 ban of the product use within the industry. At present, the shift toward the use of alternative
32 construction materials in the construction industry has done very little to eliminate asbestos
33 use nor implement adequate risk management strategies around asbestos product use and
34 asbestos containing materials already used in buildings.

35 Considering last decades has witnessed high demand and use of asbestos product in the
36 nation's construction industry, what now becomes evident in almost every urban settlement
37 is the production of large amount of ACM waste readily found among other wastes on
38 construction sites and open field where most construction wastes are indiscriminately fly-
39 tipped. This practice facilitates suspension of asbestos dust in the immediate environment
40 thereby, constituting health hazard (Obiakor 1981, Ogu and Ogbuozobe 2011). The challenges
41 posed by this scenario revealed the depth of challenges needed to control and reduce
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1 occupational and para-occupational exposure of asbestos in the Nigeria. Several factors
2 contribute to these challenges, which include lack of awareness of occupational hazards
3 among workers and managers, low numbers of trained personnel, lack of or inadequate
4 equipment and facilities to monitor exposure, inadequate infrastructure to identify and
5 evaluate the risk, which informs sound policy development and preventive measures. To
6 ensure success for any policy aimed at the prevention of asbestos exposures there is the need
7 to encourage active participation of workers at each stage of the policy development and
8 implementation. For this to work, site managers, supervisors, and trade union representatives
9 will all have to take on roles to ensure effective social dialogue and participation (ILO, 2013).
10 It is easy to suggest increased exposure risk among workers in the country is associated with
11 the culture of lack of provision and use of respiratory protective equipment (RPE). Typical
12 practices among workers on construction site is to use clothes worn from their homes as work
13 attire. The implication of such practices is that with the lack of appropriate PPE usage on site,
14 workers not only expose themselves to asbestos fibres and other pollutants but they can
15 transport the materials home on clothing, hair and footwear, thereby contaminating their
16 indoor environment and exposing their partners and children to asbestos fibre (Joshi and
17 Gupta, 2004, Tanko and Anigbogu, 2012, Kolo, 2015).

25 **3. Asbestos exposure among construction workers in the country**

26 There is evidence pointing to early attempts made by the Nigeria government at looking into
27 occupational asbestos exposure and possible health effects among construction workers as
28 far back as 1976 (Okere, 1986) and in 1991, the World Health Organisation commissioned a
29 study to undertake an inventory of ongoing research in Occupational Health and
30 Environmental Epidemiology in Developing Countries (WHO, 1991, Levy and Seplow, 1992).
31 Despite these past efforts, very little progress has been made on asbestos exposure survey
32 and monitoring in Nigeria. In addition, there is no official record of mortality or morbidity
33 rates caused by asbestos exposure within occupational and non-occupational settings in
34 Nigeria. Park et al. (2011) calculated the predicted mortality cases for several countries that
35 do not have data on mesothelioma frequency, of which 140 cases was predicated for Nigeria
36 and ranked fifth in the continent based on 15-year cumulative mortality resulting from use of
37 asbestos between, 1994-2008 (Table 1). There are grounds to conclude that actual
38 mesothelioma cases in the country might be much higher, due to the high amount of the
39 ACMs used in the past and poor pathologic diagnosis of presented cases. Other factors that
40 might have contributed to the silence around mesothelioma and other exposure related cases
41 in the country is attributed to the nonexistence of documented work exposures data among
42 workers before the industry closure and the non-availability of environmental exposure
43 record due to non-occupational reason. In 2015, the Nigeria Federal Ministry of Health
44 implemented a national strategic action plan for the prevention and control of non-
45 communicable diseases. The strategic action plan estimated 100,000 incident cases of cancers
46 in general are reported annually in the country and with an estimation that the burden can
47 increase fivefold if nothing is done by the 2020. A recently documented case evidenced poor
48 diagnosis where a patient with malignant pleural mesothelioma was treated for pulmonary
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1 tuberculosis (Oluwafemi et al., 2016) reflecting some of the challenges to addressing the
2 problem. Based on this scenario around 1,000 or more from the incident cases reported by
3 the Federal Ministry of Health might be associated with occupational asbestos exposure.
4 Although there was no mention of annual mesothelioma mortality cases in the strategic plan,
5 causal associations between high use of asbestos products in the construction industry and
6 asbestos fibre exposure, related cancer cases and other forms of chronic respiratory diseases
7 are likely. To improve working conditions and reduce exposure to asbestos fibre, investment
8 in human capital through professional capacity building is ripe and will enable the
9 implementation and monitoring of strategy aimed to reduce work related disease caused by
10 asbestos fibre exposure.

11 A literature review and data search undertaken to determine training and awareness of
12 asbestos handling in the Nigeria reveals a lack of such investment. There is need for a national
13 survey to understand the state of training and awareness provision around management of
14 asbestos to help ascertain the extent of human capital investment required in the
15 construction industry. This is particularly relevant considering the lack of enforcement around
16 the use of respiratory protection equipment (RPE) among construction workers while on site.
17 In addition, the social and gender worker demographic in the industry revealed in some
18 instances children accompany women to work on construction site, where in some cases
19 these infants are carried on the backs of female workers while at work thereby exposing them
20 to higher pollution rate (Tanko and Anigbogu, 2012, IARC, 2012, Kolo, 2015). Findings by
21 Rosenstock et al. (2006) revealed that despite the geographical boundaries between
22 developing countries, there are certain similarities that impact on occupational exposure to
23 hazards such as asbestos fibre among the work force in these countries. The nature of the
24 construction industry in the country means much activity occurs at micro level and the lack
25 of compliance systems and associated workforce to monitor the industry, through
26 enforcement, consultancy and general duty of care and corporate responsibility means the
27 use of asbestos-based materials have gone uninspected for too long. To expand on this, at
28 present in Nigeria, there is lack of clarity around which government agency is responsible for
29 the implementation of the country's National Environmental (Construction) Regulation 2011
30 Section 14; use of asbestos considering that several departments are players but are viewed
31 as operating in a "silo" fashion, which inhibit flow of information between each government
32 department. In furtherance, the lack of published data on asbestos exposure awareness and
33 training among construction workers in Nigeria emphasises the likelihood that workers on
34 construction site will not be able to reliably identify building materials containing asbestos
35 thereby further exposing themselves to inhalation dangers. In this case, any hazard and risk
36 management prepared for the site might not be adequate to safeguard individuals from risk
37 of exposure to asbestos fibres. This further highlights the need for pro-active measures aimed
38 at increasing compliance and enforcement of existing health and safety regulations to reduce
39 the risks associated with asbestos exposure. A policy of establishing data collection systems
40 need to be introduced through local and regional agency bodies, from which an effective
41 prevention strategy can be designed and implemented. This would require strategic efforts
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1 to aid the development of appropriate channels capable of gathering exposure data from
2 construction workers and medical practitioner reports. By encouraging regular environmental
3 and health surveillance among workers within the industry, this will help identify vulnerable
4 groups especially those with a long history of work in the industry and provide a good
5 platform where workers can report misdiagnosed or new cases of asbestos related disease
6 resulting from occupational exposure.
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9 The federal government through its agency, the National Environmental Standards
10 Regulatory and Enforcement Agency (NESREA) has the responsibility of enforcing
11 environmental laws, guidelines, policies, standards that include use of asbestos in any
12 construction work type (NESREA, 2017). However, the extent to which the task has gained
13 momentum among the stakeholders is difficult to ascertain due to non-availability of
14 information released by the agency to the public. With the lack of clear regulatory regime for
15 asbestos handling in the country, it is imperative that good practices around exposure survey
16 should be considered from successful practices elsewhere where there are functional
17 regulatory frameworks. For example, the UK Health and Safety Executive has relevant
18 information that if considered could assist in the risk assessment and management of
19 asbestos exposure in Nigeria.
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22 **4. Assessment of Asbestos regulatory framework in Nigeria**

23
24 While new construction use of asbestos products in Nigeria is in decline, the dangers of
25 exposure to existing asbestos cannot be overstated. The decline in use is partly due to
26 innovation in architectural design and the ban from asbestos mining and production in South
27 Africa where most of the asbestos products are shipped and distributed around the African
28 continent, including Nigeria (Braun and Kisting, 2006, Frank and Joshi, 2014). Despite this
29 decline, there is little evidence of sound policy or strategy around the management and
30 exposure prevention in old building stocks within the country. Considering that buildings
31 containing asbestos products at regular intervals are either renovated or demolished in the
32 country to make way for new structures, the lack of adequate decontamination protocols in
33 the process will contribute to the disease burden. Fibres are very likely to escape into the
34 immediate environment thereby increasing workers risk of exposure and at the same time,
35 presenting higher chance of environmental exposure especially to residence living close to
36 the construction site.
37

38
39 Because of the long latency period of between 15-60 years from the first asbestos exposure
40 to the disease onset, the need to prevent exposure is paramount in order to reduce future
41 cases of asbestos-related disease in the Nigeria. As part of the strategy, the National
42 Environmental (Construction sector) Regulation 2011 section 14 (1) (2) prohibits the use of
43 asbestos at any construction sites. In addition, the regulation has placed the responsibility on
44 the operator to ensure every asbestos-containing material (ACM) is removed from the
45 structure prior to demolition or any form of renovation that is capable of releasing the fibre
46 into atmosphere. However, the regulation is silent around the management of asbestos in
47 non-domestic buildings, where renovation or demolition occurs especially when property
48 owners are renting the property to new clients or the building is converted for non-residential
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1 use. Considering the unique nature of domestic construction work in the country, where local
2 tradesmen who are less likely to have training and awareness around asbestos exposure
3 mostly handle such projects, the regulation has not provided clear guidance on how removal
4 of ACMs will be monitored.

5
6 The Nigeria Building Code (2006) section 7.49.1 emphasises the need to consider workers
7 health at every step of construction work undertaken:

8
9 “Whenever a building or structure is erected, altered, repaired, removed or
10 demolished, the operation shall be conducted in a safe manner and suitable
11 protection for the general public and workers employed thereon shall be provided”

12
13 While this can be viewed as a significant health protection measure, the Building code lacks
14 explicit emphasis around refurbishment or demolition surveys to identify the presence of
15 asbestos containing materials, and it is this gap in worker risk assessment, which has not taken
16 into consideration worker health, safety and wellbeing. While legally it is the responsibility of
17 non-domestic property owner to manage asbestos in their premises, the case of Nigeria is
18 unique due to the absence of strict regulations put in place to enforce the control measure.
19 In addition, the Section 7.60.1 of Nigeria Building Code also gives special attention around
20 hazardous material, which could pose a danger to the health of the worker:

21
22 “Every construction or maintenance operation which results in the diffusion of..., dust,
23 stone and other small particles, toxic gases or other harmful substances in quantities
24 hazardous to health shall be safeguarded by means of local ventilation or other
25 protective devices to ensure the safety of the workers and the public as required...”

26
27 The need to conduct effective risk assessment and evaluate the nature of the remediation
28 work to be carried out is imperative to demonstrate adequate provision made to protect
29 workers health involved in either demolition, maintenance, repair or refurbishment of
30 building suspected as having asbestos containing materials (WHO, 2012, Lee et al. 2013). To
31 add to this, the need for caution was earlier made in the 1986 Asbestos Convention, 1986
32 (No.162) as contained in Article 10 that;

33
34 “Where necessary to protect the health of workers and technically practicable,
35 national laws or regulations shall provide for one or more of the following measures
36 (a) replacement of asbestos or of certain types of asbestos or products containing
37 asbestos by other materials or products or the use of alternative technology,
38 scientifically evaluated by the competent authority as harmless or less harmful,
39 whenever this is possible; (b) total or partial prohibition of the use of asbestos or of
40 certain types of asbestos or products containing asbestos in certain work processes”.

41
42 To be able to apply asbestos convention standards in Nigeria context, there is an urgent need
43 to harmonise political will, operational and information tools that can bring asbestos risk
44 management within the country to the fore (WHO, 2007). In addition, it is not too late for the
45 relevant Nigerian authorities to consider developing a central register for health surveillance
46 of individuals previously exposed to asbestos fibre. If done, the move will help improve early
47 diagnosis and treatment as well as development of adequate social and medical rehabilitation
48 scheme.

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1 Drawing on lessons of asbestos legacy in many countries, and the issues highlighted in this
2 discussion paper, the significance of chronic asbestos related disease remains a major public
3 health concern in Nigeria. To the best of our knowledge, there is minimal research around
4 asbestos exposure and asbestos related disease in the Nigeria construction industry and our
5 paper's aim is to stimulate discussion among professionals to facilitate dialogue and debate
6 that will lead to adoption of policy designed to reverse the menace caused by occupational
7 exposure to asbestos. Although, the National Environmental (Construction sector) Regulation
8 in Nigeria has set out legal duties on the control and management of asbestos, there is no
9 specific guidance in place that provides practical advice on how to comply with those
10 requirements and ensure standards are applied consistently to protect employees from risks
11 related to exposure to asbestos.
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17 **6. Conclusion**

18 With undocumented anecdotal data, suggesting asbestos containing materials (ACM) are still
19 in use in construction, and given the lack of asbestos survey practice and data collection in
20 Nigeria, strategic investment in assessment and compliance systems are needed to control
21 and minimise the risks to the general health of construction workers, and to protect public
22 health more broadly. Hence, the relevant government body responsible for monitoring of
23 ACM ban should consider a hazard and effect management process (HEMP) in their overall
24 health safety management system as a means to address asbestos exposure risk among
25 construction workers. Such a system will assist in the identification of individuals that might
26 be exposed, and assist in the implementation of controls to prevent further exposure.
27 Furthermore, the process will allow the development of a robust system of control measures
28 as a means of eliminating or reducing the hazard while identifying the critical control measure
29 and activities needed to maintain any developed control measure.
30

31 Based on paucity of Nigerian data on this issue, the authors are of the view that this paper is
32 timely and will help stimulate conversation on the subject among different stakeholders
33 within the country. Furthermore, due to the lack of information on the subject, it is almost
34 impossible to estimate the number of individuals at risk of exposure to asbestos fibre in
35 Nigeria. With an increase in general cancer cases, including lung cancer reported by the
36 Federal Ministry of Health Strategic Plan, the historical evidence of asbestos use in the
37 Nigerian construction industry, and with the long latency period of asbestos related disease,
38 there are indicators on ground for unaccounted asbestos related disease within the country
39 that is higher than any assumed figure. Since there is no safe exposure limit to asbestos fibre,
40 a national asbestos exposure survey is needed to ascertain the extent of the problem within
41 the construction industry.
42

43 To improve workers safety in the construction industry, personal respiratory equipment (RPE)
44 compatible with other PPE should be encouraged as well as the need to have in place a robust
45 system in place to monitor the management and handling of asbestos product within the
46 nation's construction industry. To conclude, the lack of information on asbestos exposure
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1 within the construction industry in Nigeria calls for urgent need to encourage research in this
2 area.

3 **Conflict of Interest**

4
5 There is no potential conflict of interest related to this article
6

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8
9 This research did not receive any specific grant from funding agencies in the public,
10 commercial, or not-for-profit sectors.
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5th May 2018

Dear Editor-in- Chief
Patrick Waterson

Cover Letter:

Enclosed is a revised manuscript titled "**What will go wrong has gone wrong- Risk of asbestos exposure among construction workers in Nigeria**" with all reviewers comments now addressed. This manuscript is not being considered for publication elsewhere.

The theme of the paper aim was to raise the safety awareness and arouse stakeholders thinking on how best to manage occupational asbestos exposure especially in developing countries. Key findings point to the fact that due to lack of cooperation from all stakeholders there exist a big black hole around the subject and is viewed as setback toward finding lasting remedy to what has already gone wrong.

Many thanks for considering my contribution for publication with the journal

Yours sincerely

Haruna M. Moda

A handwritten signature in black ink, appearing to be 'H. Moda', with a large, sweeping flourish extending to the right.