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Paraffin dangers and health and socioeconomic consequences: Urgent need for policy action

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Illuminating paraffin (kerosene) is the primary cooking fuel for approximately two million South Africans. The highly flammable and toxic fuel is burnt in poorly made stoves that are prone to malfunction and are associated with accidental fires, burns and household air pollution. However, the fuel continues to be used as it is easily decanted, widely available in neighbourhood outlets, perceived as affordable, and often the only available option for low-income urban settlements. It is anticipated that increased and enforced home congestion during COVID-19 lockdowns will exacerbate exposure of homebound families to unsafe energy, especially during the cold winter months. Based on an accumulation of evidence on the health and socioeconomic impacts of paraffin, this article advocates for its expedited phase-out and substitution with safer energy.

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The connections between energy poverty, health and wellbeing are well documented.^[1,2] Energy-poor households spend a disproportionate amount of their income on energy procurement, are exposed to elevated levels of air pollution, and risk serious injury or death when using badly designed or defective appliances.^[3] In South Africa (SA), these issues play out continuously in the sprawling urban informal settlements that are the site of glaring socioeconomic inequalities, manifest through limited access to safe energy, inferior home structures and limited healthcare.^[4,5] The problems are exacerbated by increasing unemployment, escalating energy shortages with the onset of winter, and emergence of the COVID-19 pandemic with enforced and increased home congestion^[6] and sustained proximity to unsafe appliances. The households that have substantially higher risks of injury from fires and burns are those that use paraffin.^[7] These households comprise 3.6% of the population, which equates to approximately two million people.^[8]

Every year, SA emergency services respond to over 5 000 shack fires that leave a trail of destruction, death and destitution across settlements.^[9] Survivors of these tragedies and related injuries may be scarred, with long-term physical, psychological and socioeconomic consequences. The economic impact is huge, with an annual estimated ZAR180 million lost in razed structures^[9] and a further USD26 million (ZAR490 million) spent on caring for those with paraffin burns.^[10] Indirect costs such as lost wages, prolonged care for those with physical injuries and emotional trauma, and commitment of family resources add to the socioeconomic impact. Young children, adult men and the elderly form the largest proportion of casualties.^[11,12] Unsafe energy is a health crisis causing devastation arguably comparable to, and more protracted than, COVID-19, with nearly 100 000 burn injuries of all causes in SA in 2017 alone.^[13] Yet there has been no proactive official response to this crisis, and no solidarity fund has been mobilised.

It is likely that increased and enforced home congestion during COVID lockdowns, and extended school and work closures, have exacerbated the exposure of homebound families to unsafe energy,

especially in winter time. With constrained incomes, poor families must grapple with acquiring not only food, but also the energy to cook, heat and light their living spaces, and for informational services that are vital for protection in the pandemic. Projected Eskom supply constraints^[14] will worsen the situation and lead to increased use of paraffin stoves for heating, substantially raising risk profiles.

The technology for clean energy does exist, however, exemplified by grid electricity and solar power, and a range of clean combustion fuels, such as ethanol, biogas and liquefied petroleum gas (LPG).^[15] What is lacking is the necessary political commitment to the development of clear policy guidelines and the requisite budgets for the dissemination of safer energy, especially in vulnerable communities. The transition away from dangerous paraffin and risky stoves to safer energy would be a vital step in the promotion of health, wellbeing and community development. It is argued that prevailing energy poverty may jeopardise the attainment of Agenda 2030 on Sustainable Development, particularly the realisation of Sustainable Development Goals 1 (End Poverty), 3 (Health and Wellbeing), 5 (Gender Equality) and 13 (Combat Climate Change).^[16] The SA government itself stands to benefit hugely from providing safer energy through reductions in public health expenditure and emergency response budgets. Failure to take decisive action will perpetuate and deepen the marginality and social insecurity that are an everyday reality for millions of South Africans.^[17]

Accumulating evidence for paraffin phase-out

There is an international body of literature on the dangers of paraffin as a household fuel and experiences with its replacement and substitution. The featured cases are from Global South developmental states with a similar socioeconomic trajectory to SA. These countries have largely replaced traditional solid fuels with liquid fuel (mainly paraffin), but have yet to fully embrace modern household energy carriers such as electricity and LPG. We illustrate a few studies on experiences with paraffin stove failures and human interactions with

the impaired technology, fuel toxicity, and best practice on paraffin substitution.

Persistent stove failures and user challenges

A recent SA study highlighted the poor quality of paraffin stoves certified for sale in the country. The study monitored the use of 150 new South African Bureau of Standards-approved paraffin stoves in a random sample of households in an informal settlement on the outskirts of Johannesburg.^[18] The study revealed widespread failures of key stove safety components such as auto-extinguishing mechanisms to protect against conflagration, flame control levers and leakproof tanks.^[19] The reported stove failures occurred within days to weeks of first use. Laboratory tests on a subset of the damaged stoves showed that the failures were mostly due to manufacturing shortcomings and non-compliance with the compulsory paraffin stove specifications.^[20] These findings are similar to those of an earlier study, which reported that a significant proportion of burns in SA and other developing countries are related to the design, construction and mechanical instability of domestic fuel combustion appliances.^[21]

Paraffin stove explosions are described as the most common cause of burns seen in Kenyan, Nigerian, Egyptian, SA and Indian hospitals.^[21-25] The risks of explosion and injury are compounded by use of damaged stoves,^[19] refilling lit stoves,^[22] the unwitting use of contaminated fuel,^[23] and inadequate stove safety knowledge.^[18] Other risky stove use behaviours include using appliances without fuel caps, ostensibly to guard against explosions, using the stoves for prolonged periods as heaters, leaving lit stoves unattended, and moving a stove while in use.^[18,19]

Poisonings and air pollution

Paediatric poisoning is another danger, affecting ~3.6% of paraffin-using households,^[26] with children and intoxicated individuals being the main victims.^[27] The lack of SA regulations on labelling paraffin as a poisonous substance may be a factor contributing to unintentional ingestion.^[28] Paraffin is equally indicated as the most common cause of accidental poisoning among hospitalised children in Nigeria.^[29] There is some evidence that paraffin emissions may impair lung function and increase susceptibility to infectious illness, including tuberculosis, asthma and cancer.^[30,31] A recent study in parts of Northern Italy, where local atmospheric pollution is among the worst in Europe, has demonstrated a possible link between polluted air and high SARS-CoV-2 mortality.^[32] Prolonged exposure to air pollution, especially at proximate household level, may therefore be considered a co-factor in COVID-19 negative outcomes. In addition, paraffin use, especially in simple lanterns, may contribute to emissions of black carbon, a major cause of climate change.^[33] These adverse health effects can be permanently mediated through better policies that support substitution of the dirty fuel with cleaner and safer alternatives.^[25,31]

The growing case for alternatives: Electricity and LPG

Although electricity is a preferred energy carrier and a reported 90% of SA households are connected to the grid, it cannot be relied on for all energy tasks owing to unscheduled power outages and unaffordability, especially to low-income households. These limitations cause even on-grid houses to maintain or revert to the use of paraffin and other dirty fuels as a back-up for thermal-intensive tasks.^[34] Of the clean fuel options, LPG is arguably one of the best practical replacements for paraffin owing to better overall performance in terms of technological and usability attributes.^[35,36] The use of LPG and electricity, each deployed according to relative advantages, is recommended as a community health protection

strategy in resource-poor settings.^[37,38] A best practice for large LPG dissemination programmes in the world is the Indonesian megaproject that converted 50 million households from the use of paraffin to LPG between 2007 and 2011.^[39] Evaluations indicated that the programme succeeded in reducing extreme energy poverty, burn injuries and poisonings, and saved on domestic fuel expenses and paraffin subsidies.^[40,41] SA's own exploration of LPG diffusion, despite misperceptions about affordability and safety,^[34] has itself provided encouraging results in terms of user satisfaction and the catalysation of local value chains.^[42]

Conclusions and policy recommendations

This article has provided indications of the accumulation of increasingly compelling evidence on the adverse health and socioeconomic impacts of paraffin fuel and the need to address the problem with finality. Recent research has indicated clean energy substitutes for paraffin based on global best practices, local experiences and recommendations from health authorities. Based on the foregoing, a 'No Paraffin! Campaign' is being launched in SA in February 2021 to advocate for an immediate schedule for the phase-out of paraffin as a household fuel in SA and its replacement with a safer alternative. For energy-impooverished households, this transition must be driven and enabled by the state with support of multi-stakeholder civil and corporate consortia. It is, however, recognised that energy transitions are often slow evolutionary processes that governments must catalyse and direct to achieve a desired end, in this case universal access to modern energy by 2030. In the interim, the relevant government departments are called on to improve enforcement of the compulsory stove regulations to curtail the sale of impaired appliances.

We make the following timebound policy recommendations based on recent investigations and the prevailing situation in SA:^[19]

Interim/immediate measures (within 12 months)

- **Strengthened design of stoves.** The compulsory paraffin stove standard (SANS1906:2012 Ed3.1)^[20] should be urgently reviewed to make it more stringent and directed towards enhanced performance of critical safety features such as the self-extinguish mechanism, flame control, mechanical stability and a leak-proof tank.
- **Strict enforcement of consumer protection measures.** The National Regulator for Compulsory Standards should rigorously discharge its national responsibility for the enforcement of the compulsory paraffin safety standards to curtail the manufacture, distribution and use of substandard stoves. Currently its role appears ineffectual, as non-compliant products continue to be manufactured and distributed with the official mark of approval.
- **Safety educational campaigns.** Community awareness campaigns are necessary to disseminate information on the safe use of appliances, including not refilling lit stoves or operating them without fuel caps, not leaving lit stoves unattended or letting children near stoves and heaters, and storing fuel out of reach of children in marked child-proof containers. It is anticipated that such an approach, when combined with the technological changes and standards enforcement, stands a good chance of promoting public health.

Short- to medium-term measures (1 - 3 years)

- **Paraffin substitution with safer energy.** The government is called upon to develop and enact a substantive policy for the phase-out of illuminating paraffin as a household fuel in SA and its

substitution by safer alternatives. Key elements of the policy should include identifying the safe energy to disseminate, setting up distribution networks if required, imparting awareness education on safe uses, financial support for household acquisition of the kits (e.g. stove, heater, cylinder), a subsidy for monthly refills for indigent households, and post-intervention evaluations to deal with emerging issues and inform on impacts. The government is called on to publish a White Paper with timelines on the gradual phase-out of paraffin and replacement with the chosen alternative.

Relevant government agencies, including the national departments of Trade and Industry and Human Settlements, and provincial and local government entities on safe energy access, should promote measures that enable the use of proven clean and safe energy technologies and end activities that encourage or support the use of paraffin. In this regard, paraffin should not be considered among the 'suitable off-grid energy sources' that are listed in the Free Basic Alternative Energy Policy.^[43]

The above policy changes, especially the action on paraffin substitution with cleaner and safer energy, are expected to have the following benefits: a reduction of injuries and property losses from paraffin incidents, human and environmental health promotion through reduction in household air pollution, and greater savings on household energy budgets and public health expenditure. Ultimately the policy changes should ensure that no South African remains trapped in extreme energy poverty, which limits the attainment of healthier and safe living.

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