



MAKERERE UNIVERSITY LUNG INSTITUTE

# Newsletter



## Word from the Director



Dear Readers,

I welcome you all to enjoy the stories in our December issue of the MLI newsletter in 2022.

I am happy to report that the Institute has remained fully operational during the year thus far. In research, we have had projects initiated, those that are ongoing as well as those that have been concluded. You may gain some insight during your reading. Many thanks to our funders and collaborators on different projects.

The Lung Institute Clinic has continued to grow and we welcome more patients to receive high-quality care at the institute. With increasing capacity in our screening and diagnostic services, we anticipate improvement in the Clinical care we are delivering to our patients.

I wish you an enjoyable read.

Science for healthy lungs as we build for the future.

*I wish you an enjoyable read.*

*Science for healthy lungs as we build for the future.*

### Inside....

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## The dilemma in defining Clean Energy versus Dirty Energy

Shelton Tendai Mariga, Research Scientist – MLI



### Fossil Fuels and Biomass Fuels as major Household Sources of Energy

More than 90% of the Uganda population depends mainly on firewood and charcoal for domestic cooking and heating. Charcoal is commonly used in urban settings. Firewood remains the major biomass fuel that is in some instances, freely accessible to



rural populations. While for some urban users, due to the technical/logistics' conveniences coupled with social status permitting individual affordability, such factors have gradually driven some of the urban users to resort to the unflued Liquid Petroleum Gas (LPG) cabinet heaters. These are portable heaters incorporating a ~9kg LPG bottle designed to be used indoors posing some risk of fire, leakage, and carbon monoxide (CO) poisoning as well as exposures to other unprecedented or not well-defined toxic metabolites of **More on p.2**

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LEVERAGING 100 YEARS OF EXCELLENCE  
IN BUILDING A TRANSFORMED SOCIETY

**From p.1** fossil fuels.

The main fossil fuels are gas, oil and coal, kerosene, LPG, and compressed natural gas (CNG). However, the intrinsic differences between coal (one of the worst polluters) and gaseous fuel, besides its physical structure, are the concentration levels of the chemical species found in LPG which are estimated at ~50% less than coal.

**Relevant Household Air Pollution Scoping Studies.**

Recently, households' air pollution particulate monitoring studies have been undertaken in urban Slum Dwellings (Kampala). MLI researchers reiterated the universal notion that biomass fuel and fossil fuel smoke particulate matter in many LMICs households cooking, still generated high concentration levels, of a diverse number of particle fractions of different sizes including  $PM_{1.0}$ ,  $PM_{2.5}$ , and  $PM_{10}$  are far above the WHO guidelines. However, the technology used to routinely measure fine/ultrafine fraction sizes remains a challenge, especially in the nanoparticle size ranges, since as the mass becomes negligible, the ultrafine particles become quantifiable in counts, instead.

Lascar USB, a low-cost monitor used for the assessment of the household air pollution concentration levels in the Namuwongo studies, was only limited to the lowest detection limit of 1  $\mu g$ . The evaluation of the data analysis using correlation coefficient regression analysis demonstrated an extremely close relationship between the lowest measured sizes  $PM_{1.0}$  and  $PM_{2.5}$ . Their correlation coefficient ( $R^2$ ) of the two smallest size metrics reported in the study, was almost unity, 0.9904. Fine particles, as well as ultrafine sizes, are also known to be more relevant to the health effects in terms of the extent of penetration into small blood vessels, reaching out multiple organs including crossing the blood brain barrier.

**Combustion-related gaseous and particulate matter fractions distribution.**

In these preliminary studies, the extremely high concentration levels above 200  $\mu g/m^3$  of particulate matter were measured at some fraction sizes ( $PM_{2.5}$ ,  $PM_{10}$ ) from biomass fuel burning smoke. Conspicuously, though relatively lower than in charcoal households, high particulate matter air pollutants concentration levels, were also reported in smoke emissions from households using LPG stoves. These findings have reinforced the critical need for future planning for a source apportionment design to perform comprehensive chemical speciation of  $PM_{10}$  for a diverse number of species/parameters from active sampling indoors.

**Empirical Evidence Carcinogenic Compounds and Green House Gases in Smoke from LPG.**

Furthermore, studies mentioned above among others elsewhere, explain why gaseous fuel such as LPG has lost its mantra as one of the clean sources of energy. It is now merely defined as one of the fossil fuels, closely resembling coal in composition. Some of the studies in which LPG is previously claimed to represent clean energy are being refuted by those designed for the chemical speciated analysis conducted in low-income middle countries, which were able to tease out several highly toxic benzene metabolites/derivatives captured in the LPG-related gaseous smoke and fumes.

The critical capital infrastructures stipulated in the safety and health guidelines before implementation, their installation, and assurance for proper maintenance are required as a prerequisite before using LPG for gas burning. Thus, hoods and exhaust furnaces which are exhausting smoke and fumes out of the kitchens are supposed to be pre-installed in houses intended for using the gas stove for cooking to ensure there is efficient pressurized air blowing of exhausts into the atmosphere with heavier cleaner air coming in to replace the

rising warm exhaust air. However, this remediation measure might appear to protect the household and its neighboring communities from the toxic particles/gaseous fumes, several greenhouse gases (i.e. methane,  $NO_2$ ,  $CO_2$ ) commonly released still add up to the atmospheric global warming much more exhibited in troposphere.

**Hoods and Furnaces Mandatory in LPG Households Users.**

In developed countries gas stoves have been used for several decades, for domestic cooking and commercial enterprises, under stringent safety/healthy measures coupled with their users' compliance to sets of technical guidelines for using the systems. Nevertheless, there are still several shortcomings brought about by this technology as various toxic pollutants associated with fuel-related smoke/fumes including benzene derivatives known to be carcinogenic are generated from the burning of domestic gaseous fuels.

The hoods and furnaces are conventionally part of the built-in infrastructures supposed to vent their exhaust gases out of the indoor air around them which, without adequate ventilation, can degrade indoor air quality with a variety of dual adverse consequences both to health and climate change. Concerns have arisen about their continuing suitability for use, particularly in residential settings that have no provision of basic facilities to protect the stove users.

Furthermore, there are few epidemiological studies carried out to establish the association of these constituents present in the fumes/smoke hence much of the claims remain speculation more than facts. Empirical studies relevant to establishing the health effects of all the common cooking fuels under the low-medium income countries' settings are proposed to compile data that would inform any decisions on policy particularly if we are to move from the use of biomass fuels/fossil fuels to clean energy with renewable energy in mind.



## Gas systems in the Mainstream in equivalence to Water supply Systems & Fugitive Leakages of LPG.

In other parts of the world, the gas supplies to the households are part of the mainstream piping systems, similar to the water supply systems, permitting the safer and logistically easing the availability of the fuel to the user without the inconveniences caused by loose cylinders carried around on the street. For us, in the developing countries to now raise our bar to that level of a supply chain that safeguards the health of the household user, high investments are bound to be the answer to at least be able to put the minimum capital infrastructures before defining a safe and healthy environment ready for using fossil fuels, indoors.

Technical establishments to protect LPG stove users, and piping connections for gas delivery to the homesteads tend to be running in resemblance to the water systems. This, portrays network that has reduced the risks involved in the portability of the gas cylinders completely protecting the users as to focus on the maintenance of the gas system by checking and sealing off the fugitive leakages. A situation of this nature needs extensive proper planning, designing, and engineering to achieve the technical settings to obtain the safety and healthy households i.e. Katanga.

## Resources for Renewable related Infrastructures.



The good news, is resources of alternative energy to fossil fuels are in abundance, largely untapped, in Uganda. Since there are derived from natural resources (hydropower, solar power, wind power) continuously replenished, renewable energy is key to a safer, cleaner, and sustainable world.

Renewable energy is based on technologies that get cheaper as we make more. Nevertheless, the resources that are currently planned for and bound to be put into as the capital investment for building the infrastructures for gas stoves usage to attain international standards, would be instead, sustainably diverted

to a more long-lasting renewable energy strategy that has a favorable dual impacts, for both human/environmental health and the green gas house effects. Although in short term the dream of mass electrification country-wide including rural areas might appear a far cry, considering the costs, the benefits of renewable energy that can be taped from our natural resources in Uganda is massive, that will eventually save life as well as extensively reducing the medical expenditures incurred today.

We are geophysically located at or within the equatorial region, endowed with receiving all types of rainfall including conduction,

convection, condensation, and various humid currents that converge in creating a climate that has resulted in maintaining a perennial green landscape and annually flowing rivers and streams. Thus, no excuse for not leveraging a hybrid system, for the mobilization of solar energy, hydro energy, wind energy, and geothermal energy together, particularly investments that are configured in a hybrid-synergy-production chain that has a beneficial effect on reducing the input costs. The use of renewable energy, not only clean but sustainable for the next generations, is a legacy that we owe those who are to come after us, building an energy wealth for the born and unborn.



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# Uganda on Countdown for Ebola Trial



**Zahra Namuli Ssentongo, Journalist and Communication Specialist, MLI**

The Ministry of Health in partnership with World Health Organization is making final preparations to kick off the Ebola Vaccine trial in Uganda.

Top Ministry of Health and WHO Representatives visited the study base in Mulago Hospital to assess the readiness to rapidly start the clinical trial when the candidate vaccines arrive.

The Minister of Health, Dr Jane Ruth Aceng, and the WHO Country Representative, Dr Yonas Tegegn Woldemariam toured the clinical trial base in Kampala and took stock of equipment procured for use during the Trial.

These included supplies the cold chain, Personal Protective Equipment, study tablets for the research teams, and other medical material.

The Principal Investigator Prof. Bruce Kirenga told the visiting teams that Preparedness is now at 92 per cent.

The Trial Manager Dr Joanita Nalunjogi explained that five research teams have been recruited, trained and are ready for deployment once the vaccines arrive.

According to the World Health Organization country representative Dr Tegegn, the team is looking at three candidate vaccines to use in the trial



including the CAD3 Sabin vaccine, CADOX1 from the University of Oxford and the rsvs the Merck/IAVI Vaccine to test whether one or more will protect against Ebola caused by the Sudan Ebola virus.

Dr Aceng points out that Uganda is doing a groundbreaking work which will have uses far beyond the current outbreak.

*"We shall be providing science to the whole world when all this is done"* she said

She highlighted the importance of the research teams following the research

protocol that has now received necessary approvals from ethics and other regulatory committees and noted the strong leadership from the Principal Investigator, Prof Kirenga

As of the 26<sup>th</sup> November, the Ebola outbreak in Uganda documented 141 confirmed and 22 probable cases (total 163 cases) of which there are 55 confirmed deaths and 22 probable deaths (total 77 deaths).

There are 544 active contacts listed in five districts. Altogether 3802 contacts have completed 21 days of monitoring.





# Air Pollution



**Stephen Kyaligonza Nyakoojo, Air Pollution – Senior Field Officer, Makerere University Lung Institute (MLI)**

Air pollution is dirty air, breathing dirty air is as bad as drinking dirty water, and they both cause diseases and poor health in our bodies.

- Polluted air (dirty air) can
- Make you cough
- Cause tuberculosis (TB)
- Cause itchy eyes
- Cause lung cancer
- Make your asthma worse

## Clean air

Breathing clean air (Air that is full of non-harmful gas particles) is very important as it has nothing dangerous or harmful to human health, hence very safe to breathe in. Our campaign (as MLI) to breathe clean air has gone a long way in improving the health of our communities within Kampala and the surrounding districts.

Clean air has few tiny particles moving freely in the air and you can reduce

these particles from the atmosphere by reducing or minimizing the following;

- Reducing or minimizing outdoor burning.
- Reducing motor vehicles, factories, emissions, and other polluting agents.
- Reducing or minimizing cooking using firewood.
- Reducing or minimizing the generation of dust.

By carrying out air quality campaigns and sensitizing our communities on the advantages of clean air, the communities have changed their lifestyles greatly.

## Particulate matter (PM)

Air is made up of a mixture of many solid particles and liquid droplets flowing freely that we can not see called Particulate matter (PM)-these are measured in micrometers – diameter ( $PM_{1.0}$   $PM_{2.5}$   $PM_{10}$ )

## Clean Energy

Where possible let's use clean energy – this is the energy we get from renewable, zero-emission sources that do not pollute the atmosphere when used.

E.g. Solar energy

Hydro energy and many others.

## Measurements

You can tell the quality of air around you by measuring using the plume flow 2 monitors that will show you, how good or bad the air around you is. This monitor is user-friendly, easy to operate, collect data in real-time, and is as light as a big marker pen that you wear on your clothes.

It cost a minimum of 200 US dollars in, the USA market.



# World Lung Day, 2022



**Dr. Simon Walusimb, Public Health Physician and Research Scientist, Makerere Lung Institute**

## Background

The World Health Organization (WHO) and the Forum of the International Respiratory Society (FIRS)) jointly designated September 25 of each year as World Lung Day (WLD) to raise awareness of the burden of respiratory diseases and mobilize action towards better lung health.

The vital importance of the lungs was highlighted by the COVID pandemic, which clearly illustrated that respiratory diseases impose immense health and socio-economic burden, and taking care of our lungs is therefore more important than ever. According to the Global Impact of Respiratory Disease report (2021),

respiratory diseases are the third leading cause of death worldwide after heart disease and stroke.

## Statistics

Respiratory health is vital for one to enjoy full health. It is now recognized that childhood respiratory disease has long-term negative consequences on adult health.

The main respiratory diseases are asthma, chronic obstructive pulmonary disease (COPD), pneumonia, tuberculosis (TB), and lung cancer-the so-called 'Big Five'. These five lung diseases are responsible for 4 million deaths globally.

Asthma for example affects 1%–18% of the world population, including both children and adults.<sup>1</sup> Childhood

asthma can adversely impact the physical and psychological development of children, besides being fatal. Similarly among adults with suboptimal control, asthma may be fatal or may result in absence from work or psychosocial morbidity.

About 10% of people aged 30–79 years have COPD worldwide. Sufferers of COPD require increased use of medications and hospitalizations from acute exacerbations which are usually recurrent events. Sadly, patients with COPD usually also present with co-morbidities like heart disease, depression, and anxiety.

Pneumonia accounts for 14% of all deaths of children under 5 years old worldwide. Elderly people aged above 70 years, with medical co-morbidities

are also at a very high risk of dying from pneumonia-related causes.<sup>4</sup>

Before the COVID pandemic, TB was the main cause of death from a single infectious agent claiming the lives of 1.5 million people annually, while causing sickness to more than 10 million people per year.<sup>4</sup> Unfortunately, more and more people are diagnosed with drug-resistant forms of TB which require longer and more costly treatment.

Finally, among the 'Big Five' is lung cancer. While lung cancer is not the most prevalent cancer (second to breast cancer), it is the most lethal form of cancer responsible for 1 in 4 cancer deaths worldwide accounting for 1.8 million deaths each year. Lung cancer is more common in men than in women. The condition is common in current and former smokers. The most common symptoms of lung cancer are persistent cough and chest pain that often worsen with deep breathing, coughing, or laughing.

### Situation in Uganda

Respiratory diseases are among the leading cause of ill health among Ugandans, despite being preventable and economical to treat. According to health statistics from the Ministry of Health, lung-related complaints account for 30% of the hospital visits in Ugandan health facilities.

Landmark studies conducted by Makerere University Lung Institute (MLI) showed that one in five Ugandan adults (20%) suffered from a chronic respiratory disease such as asthma or COPD. Risk factors included air pollution particularly in urban settings, exposure to tobacco/shisha smoke, and a history of having suffered from tuberculosis-which is a disease that primarily affects the lungs. Exposure to biomass smoke as a result of the combustion of wood or animal dung or crop for cooking and heating in many Ugandan households was the main risk factor for developing COPD in early adult life for both men and women in their mid-30s. Additional data from studies conducted in Kampala and

Jinja showed that air pollution in Uganda was on the rise, thus adding more fuel to the already existing high-risk factors for respiratory diseases in the country.

Unfortunately, access to diagnostics and treatment for asthma and COPD are not widely available in Uganda and remain largely unaffordable. Across all public or private health facilities and pharmacies, only 45%-75% have the essential range of medicines that are critical in the treatment of asthma. None of the assessed sites in the above survey had the principal long-acting medicines that are used to prevent severe attacks (exacerbations) in asthma/COPD patients. These exacerbations are the main reasons for patient hospitalization and death. In addition, the key diagnostic tests for chronic respiratory diseases namely, spirometry and peak-flowmetry were available in only 7%-24% of the health facilities and pharmacies. Sufferers of asthma/COPD often required 2 to 17 days' wages in order to afford treatment for their lung condition and 28 days' wages for spirometry testing.

Scientists at MLI have demonstrated that failure to address the burden of respiratory diseases including asthma, COPD, and TB will result in increased household poverty. For example, A survey designed to assess the economic burden due to tuberculosis (TB) patients found that

53% of households were pushed into poverty as a result of a household member suffering from TB. The situation is similarly dire for sufferers of asthma/COPD where nearly 47% miss work due to asthma/COPD.

### How to keep your lungs healthy

Taking care of our lungs is now more important than ever because the lungs are vital for health. Unfortunately, the lungs are in constant exposure to a variety of air pollutants that are present in the air we normally breathe. By far, air pollution is the most significant environmental risk to respiratory health. It is estimated that at least two billion people globally are exposed to unclean air as a result of indoor or outdoor smoke produced by the burning of biomass fuels such as wood, cow dung, and car fuels for cooking or warming.<sup>7</sup> The significance of air pollution was well demonstrated during the COVID-19 pandemic.

Figure 1Figure 1Dr. Rebecca Nantanda from MLI training students on symptoms of Asthma and causes in schools

During the pandemic, there was a reduction in outdoor activities which resulted in relatively lower emissions causing air pollutants. Hospital admission for acute exacerbation of COPD and asthma reduced markedly with the COVID-19 pandemics.



*In general, we can achieve good care for our lungs by focusing on the following interventions.*



## Breathe clean air

Air pollution kills an estimated 7 million people worldwide every year. WHO data shows that 9 out of 10 people breathe air containing high levels of pollutants.

Air pollution has a negative impact on human health and exposure to it can affect 100% of the population, from unborn babies to the very elderly. The lungs are the first point of entry for air pollution into the body and are therefore the first affected organ. Air pollution affects everyone—rich or poor. Public health authorities must realize that breathing safe (clean) air is as important as drinking safe (clean) water for the prevention of water-borne diseases. Therefore, the efforts invested for the delivery of safe piped water should be replicated to ensure communities breathe safe and clean air for the prevention of lung diseases.

## Say no to tobacco

Tobacco and similar products (vaping, sisha) cause an estimated 8 million deaths every year and is the main cause of many lung diseases. Tobacco smoke contains more than 4,000 chemicals, many of which are toxic and can cause cancer. Stopping smoking is the best way to improve your lung health and overall health. Quitting tobacco has the potential to reverse some of the damage done by tobacco smoke to the lungs, but not all. Early cessation is therefore essential to preventing

the onset of chronic lung disease, which is irreversible once developed. Several policies to end the use of tobacco have been formulated. These have been guided by the international convention on tobacco control which has been in place for more than 20 years. However, regulation and enforcement of the convention, such as the restriction of smoking in public places remain weak.

## Protect your lungs through vaccination

Getting vaccinated can protect you from lots of different infectious diseases and help you keep your lungs healthy. Pneumococcal pneumonia, COVID-19, influenza, and whooping cough are examples of respiratory infections that can be prevented by vaccination.

Vaccination can also help to protect other people. People can be protected if those close to them (like friends and family members) and enough people in their communities (including healthcare professionals) are vaccinated because it stops infections from spreading.

## Take regular physical activity

Regular physical activity and exercise improve the quality of life, whether you are healthy or you have a lung condition. Many people associate keeping fit with maintaining a healthy heart, losing weight and reducing the

risk of illnesses such as diabetes, but exercise also helps keep lungs healthy.

When you exercise, your heart beats faster and your lungs work harder. Your body needs more oxygen to fuel your muscles. Your lungs step up their activity to deliver that oxygen while expelling additional carbon dioxide. In addition, your lungs expand during exercise compared to when not exercising, preventing compression of lower lung areas.

## About Makerere University Lung Institute

MLI is Uganda's eminent research organization in lung health. Established in 2015, Driven by the **Slogan:** Science for healthy lungs, MLI partners with the Ministry of Health and local and international partners to conduct World-class research that integrates disease prevention, clinical care, and training. During the COVID-19 outbreak, scientists from MLI were actively engaged in the national COVID-19 response through guideline development and patient care. MLI continues to support the national response to TB and other chronic respiratory diseases such as asthma and COPD. MLI joins the rest of the world to advocate for lung health to be a top priority for policy and decision-makers, encouraging individuals to adopt personal behaviors that promote healthy lungs.

# Lung Cancer

Irene Najjingo, Research fellow, Makerere University Lung Institute



## What is Lung cancer

Lung cancer is a disease in the lung where the cells grow out of control and may spread to the body's lymph nodes and other parts of the body. It is the fourth most common cancer in Africa with approximately 39,300 new lung cancer cases every year. Lung cancer disease affects men and women from all walks of life.

## History of lung cancer

First described by doctors in the

early 19<sup>th</sup> century, lung cancer was an extremely rare disease for a very long time. Some 150 years ago, people had only heard of this disease, and studies showed less than 1% to 2% of the population was afflicted with it. Cut to the next century, and the scenario changed completely. While still rare in the early part of the 20<sup>th</sup> century, by the end, it became the leading cause of male cancer-related deaths in more than 25 countries.

No one knew how this happened

and what caused this dramatic rise. A scientifically significant handbook written in the 1930s — the Springer Handbook of Special Pathology — postulated that this rise could be a direct result of the increasingly polluted air, greater frequency of traffic, and even an increased exposure to gasses during World War I. But this handbook, like many others, could not explain why lung cancer also rose in countries without any of the above factors. Smoking was also suspected to be a factor, but no

particular importance was given to studying this theory. It was only when studies conducted in the 1940s and '50s showed hard evidence linking lung cancer to smoking that people realized the ill effects of nicotine and tobacco.

As smoking was now a recognized cause of lung cancer, many people globally did their best to quit this habit, and this widespread movement saw a gradual decline in lung cancer incidence, at least in males. Unfortunately for the world, lung cancer does not have only one cause. Long-term exposure (via air) to all carcinogenic materials — among them radon gas, uranium, and asbestos — plays a role in lung cancer development too. By the 21st century, lung cancer-related ailments were common and quickly displaced other forms of cancer on the mortality charts. With this upward trend came an increased awareness of lung cancers and their causes. Days and events like these are major factors contributing to lung cancer research and awareness activities.

### Signs and symptoms of lung cancer

Persons with lung cancer often don't show signs during the early stage. Patients with late-stage lung cancer can have a very bad cough, chest pain, shortness of breath, wheezing, coughing up blood, feeling very tired all the time, and weight loss with no known cause.

### Causes of lung cancer

Lung cancer is not spread from one person to another. However, lung cancer can be developed in people who have never smoked, people that smoke cigarettes, breathe in smoke from other people's cigarettes, those

who consume alcohol, or people who might have a family history of cancer. It can also be caused by physical inactivity, poor dietary factors, and exposure to chemicals and radiation.

### How can Lung cancer be prevented?

Raising awareness on potential exposures to lung cancer, providing supplements and boosters, vaccination, early detection, and treatment.

Lung cancer screening services at Makerere University Lung Institute (MLI)

MLI is an academic research institute within the Makerere University College of Health Sciences. The Institute was established in 2015 and works closely with several local and International organizations and Universities to provide specialized clinical care to the people of Uganda as well as come up with ideas and interventions to improve lung health.



In a way to improve patient health, MLI conducts several studies on lung health and among these is the "Lung cancer in East Africa and the relationship to HIV-1 infection: epidemiology, molecular characterization, and imaging"-LCH study. MLI is implementing



this study in collaboration with the Joint Clinical Research Centre, Case Western Reserve University, University Hospitals of Cleveland, and the National Institute for Medical Research, Muhimbili Tanzania.

The LCH study aims to understand the clinical and genetic risk factors for lung cancer and assess how lung cancer is related to HIV. The study will also define lung cancer using radiological features commonly known as imaging in both Uganda and Tanzania. We shall enroll lung cancer patients and follow them up for five years to assess for their outcomes. The study will inform the Ministry of Health about the risk factors for lung cancer and the treatment outcomes for lung cancer patients.

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