Vestine Mukeshimana nearly escaped death in 2008 motorcycle accident in Rusizi District, South-western Rwanda, but apart from fractured pelvic bone, also had her face, neck, abdomen and back sustained injuries during the crash.

The body injuries led to several surgeries in Rwandan hospitals, where during one of the many complicated facial surgeries she acquired an infection when bacteria formed on the alloplastic prosthetic inserted under her right eye socket. The infection did not respond to the antibiotics prescribed, and it wasn't until nearly a year later that it was diagnosed as methicillin-resistant Staphylococcus aureus (MRSA).

According to the Center for Disease Control and Prevention (CDC), MRSA is a cause of staph infection that is difficult to treat because of resistance to some antibiotic drugs. This group of antibiotics includes methicillin, and the more commonly prescribed penicillin, amoxicillin, and oxacillin among others.

Mukeshimana's infection returned in 2014, along with an allergy, after yet another surgery. This infection could have come from the hospital or resurfaced from the previously infected area and was again resistant to antibiotics prescribed to her.

Mukeshimana points out that none of the many doctors she had in the first six years of those surgeries ever mentioned antibiotic resistance to her. "I was oblivious to the dangers of stopping an antibiotic drug or even an antibiotic ointment after a couple of days when it appeared to not be working," she said.

However, through the help of her family and sympathizers she was admitted where she got better medical prescription and was sent home with detailed care attention that led to her full recovery in 2016.

The MRSA infections have been found to be predominant in the hospital settings in Rwanda and are also known to be resistant to the antibiotic methicillin and other drugs in the same class and have since been found to cause illness in the community outside of hospitals and other health facilities.

In Rwanda, MRSA infections as many other infections that have been acquired in hospital settings can be difficult to treat and can progress to life threatening blood or bone infections because there are fewer effective antibiotics available for their treatment.

Medical experts explain that infections with MRSA are usually associated with high temperatures (fevers) and signs of an infection.

Professor Faustin Ntirenganya, Surgery Senior Consultant General & Onco-Plastic Surgeon at the University Teaching Hospital of Kigali (CHUK) says that it has been observed over time that some basic antibiotics are losing their effectiveness in Rwanda where even common infections are resistant towards them.

According to Prof. Ntirenganya, many of the early antibiotics up to 80 – 90 percent face resistance in Rwanda, which leads to the use of new drugs, most in use now are the fourth generation which are more advanced and beyond them nothing else is available.

Professor Faustin Ntirenganya, Surgery Senior Consultant General & Onco-Plastic Surgeon at the University Teaching Hospital of Kigali (CHUK)

This Antimicrobial Resistance (AMR) has become an increasing concern worldwide as a public health problem, it doesn't only impact healthcare directly but causes numerous infectious diseases in Rwanda, but also diminishes quality of life leading to direct and indirect cost, according to medical experts.

AMR has risen by as much as two thirds in the last two decades, according to some studies, and its rates are high in some parts of rural Rwanda and pose a serious therapeutic challenges to the management of common infections.

A study conducted to determine the prevalence of AMR among bacterial pathogens associated with common infections in patients on the medical wards of the largest tertiary hospital in Rwanda, found that AMR is posing a serious therapeutic challenge to the management of common infections.

Of the specimens evaluated, 31.4% and 58.7% of Escherichia coli (E.coli) and Klebsiella isolates, respectively, were resistant to at least one of the third generation cephalosporins. Eight percent of E. coli isolates were resistant to imipenem; 82% and 6% of Staphylococcus aureus strains were oxacillin- and vancomycin-resistant respectively.

Prof. Ntirenganya warns that it's unfortunate that the most dangerous antibiotic

resistant microbes can be found in hospital settings and very hard to treat, known as Hospital Acquired Infections (HAI).

Some of these microbial bacteria become multi drug-resistant because of the environment they develop in where they are surrounded with various drugs making it sometimes difficult to fight them as they are resistant to more than one antibiotic.

Significant burdens related to HAIs include antibiotic resistance in 50% or more of surgical site infections and severe economic cost to healthcare systems and society. Cross-contamination with contaminated health care providers (HCPs) hands was the most common transmission way of HAIs at the hospital.

To deal with such threats, Prof. Ntirenganya says “preventive control mechanisms with a number of protocols have been established including keeping hygiene from the basic tenet of hand washing to regular disinfectant, robust infection surveillance and an antibiotic stewardship.”

This is what is being implemented at different hospitals across Rwanda to solve the HAI problem.

Dr. Valence Hakizimana, an infectious diseases specialist at Bugesera District Hospital revealed that they are using stringent disinfection products to reduce any risk of contamination.

Disinfectant solutions of 2% to 3.2% glutaraldehyde and 0.55% ortho-phthalaldehyde are the most common high-level disinfectants used in the operating room. Instruments are dried before being submerged in solution to avoid diluting the disinfectant solution.

Hospital-grade disinfectant is a cleaning solution that is suitable for sanitizing a building’s surfaces- floors, counters, etc, as it kills bacteria, pathogenic viruses, and destroys fungus and the most commonly used hospital disinfectant is sodium hypochlorite, while the disinfectant used in surgery is Alcohol-Based Solutions. Ethyl and isopropyl alcohol are two of the most effective antiseptic agents available. When used alone, alcohol is fast and short acting, has broad-spectrum antimicrobial activity, and is relatively cheaper.

The acquisition of Ultra Violet (UV-C) light robots are helping in cleaning and disinfecting at Bugesera District Hospital where they have two robots in service.

The UV-C Robots are cutting-edge technology with unique features which include the UV-C lamps that emit ultraviolet lights destroying deadly microorganisms that may be missed during the manual cleaning process, hence helping to reduce infection rates for patients and healthcare workers at 98% compared to manual cleaning that covers 52% of general disinfection at hospitals.

These robots have the capacity to undertake speedy cleaning and disinfecting patient and operating rooms, labor and delivery, ICU rooms, isolation discharge rooms and other indoor spaces. On average, one robot can disinfect one room in 32 minutes compared to human effort that takes normally close to two hours.

“The introduction of robots in our hospital’s case management has contributed to limiting human interaction between healthcare providers and patients,” says Mukeshimana Maria, the Administrative head at Bugesera District Hospital.

Only 50% of surfaces in hospital rooms are sufficiently cleaned by manual cleaning and disinfection, now with the robots being used 99.9% of rooms and other facilities are totally cleaned. Care providers and patients are also able to use the facilities within two minutes after disinfection.

Evidence suggests that manual cleaning and disinfection are often inadequate and result in residual contamination however robotic disinfection works in unmanned and standardized fashion without the need for ongoing human presence at the disinfection site. Therefore, exposure of health care workers to harmful UV radiation can be avoided during the process.

While disinfectant solutions are required to be effective to clean hospitals, some products contain dangerous chemicals like hydrogen peroxide, peracetic acid, and acetic acid that may result in adverse health effects if exposed to people like cleaners and the facility’s occupants.

Yvett Mutoni, in-charge of cleaning and hygiene at the same hospital underlines that, although they abide by regulations concerning hygiene in hospitals it was not the same before and some would be at risk of contracting diseases from waste and used equipment.

“Before RURA (Rwanda Utilities Regulatory Authority) put much emphasis on wearing protectively, workers and patients were vulnerable and were left

susceptible to diseases. Workers were not even aware of its importance but this attitude has changed which ensures our safety, hygiene and good delivery," she said.

Mukeshimana Maria observes that applying new innovations and technology present greater triumph in protecting frontline workers and prevent the spread of diseases.

She notes that, before the use of some of the new innovations, disinfecting the hospital using rudimentary ways was yielding less than 60% of the work required, hence many patients and workers would end up infected at hospital facilities.

But the new innovations are still limited because even the two robots at Bugesera District Hospital are not permanent since they are shared with other medical facilities when the need arises.

Additionally, the cost of UV-C Robots does not come cheap as one costs over Rwf. 30million (about $30,000).

At CHUK, Prof. Ntirenganya said they are using comprehensive safety programs which were established as a structured strategic framework for patient safety improvement that may not be visible to everyone. These strategies are helping CHUK keep the spread of infections at bay.

The use of Ultra-violet disinfection robots sometimes recently have also been able to destroy a good percentage of micro-organisms in the hospital. But these robots do not replace cleaning staff, who are still required to remove 'hard' stains such as blood and urine, he says.

Also, similar to other health facilities across Rwanda with a mandate to ensure the rational use of medicines including antimicrobial products, CHUK also has a Drugs Therapeutic Committees (DTC).

The current situation according to CHUK records indicate an improvement in the HAI rate which is at 6.2% . In the intensive care unit (ICU), the rate is at 17.0%, Neonatal ICU at 8.1% and Orthopedics/burn unit at 11.3%.

A previous study conducted in 2016 at CHUK revealed an overall HAI prevalence rate of 15.1% with the highest rate being in ICU at 50.0%, and the lowest rate in General surgery unit at 12.1%.

While health facilities in Rwanda have established control mechanisms to limit the risk and spread of HAIs, Prof. Ntirenganya observes that it’s not the case outside hospital settings and other sectors.

As hospitals try to decrease the risks of AMR in human, a good understanding of all threats from other sectors like animal and environmental health is required to address antimicrobial resistance in the country.

For Dr. Hakizimana much has to be done to stay a step ahead because infections require a multi-pronged solution, including safety programs, careful stewardship of the remaining antibiotics resources and providing incentives to pharmaceutical companies to be sure they stay active in antibiotic development.