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Ultra Violet (UV) Light Irradiation Device for Hospital Disinfection:

Hospital Acquired Infections Control

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ABSTRACT

The biomedical technology application of ultraviolet light device was reviewed in the current research in a manner to improve public healthcare safety. The research adopted ultraviolet light irradiation to enable elimination of hospital acquired infections caused by bacteria, viruses, and other pathogens within the healthcare facilities. The paper reviewed 12 related biomedical literature that discussed the topic of hospital disinfection using ultraviolet device technology. The paper observed that installation of autonomous internet of things 5G medical disinfecting device for continuous sterilisation of high-touch areas is important in the ongoing COVID-19 pandemic. The research concluded that installation of autonomous internet of things 5G ultraviolet device within the hospital facilities will provide a means for infectious surveillance that will effectively control the menace of hospital acquired infections through ultraviolet light irradiation as the susceptibility of hospital acquired infections are exceedingly high in the overcrowded healthcare centres.

KEYWORDS

5G Mobile Network Technology, COVID-19, Disease Surveillance, E-Healthcare, Hospital Acquired Infections Control, Internet of Things, Microbial Infections, Ultraviolet Light

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1. INTRODUCTION

Hospital acquired infections (HAIs) are among the topmost global avoidable health risk that had contributed to millions death and billion expenditures yearly within the healthcare sector (Matthew et al., 2021). The HAIs continued to dominate the public health sector wearisomeness, resulting into severe complications and the outcomes are generally disastrous with consequential loss of human life and unquantifiable resource wastages (Gottrup et al., 2013). The worldwide infection prevention and pandemic control measures have become the topmost priority of the healthcare establishments and institutional management for HAIs, in improving quality of care, patient safety and society good health sustainability (Zimlichman et al., 2013). The ultimate goal of the global healthcare system is to ensure that every patient recovers from whatever health challenges that brought them to the hospital (Borkowski & Meese, 2020). In achieving those objectives, the healthcare systems need to articulate a comprehensive safety environment which the combined emphasis must shift away from patient treatment to outright disease prevention and prompt interventions (Organization, 2017). The stakeholders must be mobilized to respond to the trends and embrace the smart healthcare conveyance toward sustainable digital healthcare future. The global healthcare reform must be comprehensively established towards driving changes in the sector and laying a solid foundation for the development of healthcare services (Tao et al., 2020). The HAIs are conventionally categorized among the infections acquired in hospital premises by patients who were customarily admitted for a reason unrelated to the acquired infection while in the hospital environment (Gesser-Edelsburg et al., 2018). The scenario described the infection happening in patients in the healthcare facility in which the infection was not observable or readily incubating as at the time of hospital admittance (Organization, 2002).

Notwithstanding the progresses made in the public healthcare, infections had continued to multiply among the hospitalized patients and that equally had affected the hospital employees who are at the forefront of the healthcare delivery. Countless factors had contributed to the infection spread among the hospitalized patients such as diminished immunity among the patients, the clinical procedures and relatively invasive techniques which had created chances for infection and administering drug-resistant bacteria among the overcrowded hospital populaces, where susceptibility of infection transmission are extremely high (Wu et al., 2020). The HAIs otherwise regarded as Nosocomial infections happen globally which had disturbed both industrialized and developing countries of the world. The Nosocomial infections are among the major foundations of death and compounded morbidity between the hospitalized patients (B Carter et al., 2020). In a certain investigation conducted under the supervision of World Health Organization (WHO), in the 55 hospitals of the 14 countries representing 4 WHO Regions, the South-East Asia, Europe, Western Pacific and Eastern Mediterranean indicated that an average of 8.7 percent of hospital patients have nosocomial infections (Organization, 2002).

In a similar development, over 1.4 million people experienced nosocomial infectious complications which they acquired in the hospital premises (Badgery-Parker, Pearson, Dunn, & Elshaug, 2019). The greatest occurrences of hospital acquired infections were witnessed from hospitals in the Eastern Mediterranean and South-East Asia regions with 11.8 per cent and 10.0 per cent prevalence, while 7.7 percent and 9.0 percent were recorded in European and Western Pacific regions respectively (Organization, 2002). The commonest hospital acquired infections are infections of surgical wounds, urinary tract infections and lower respiratory tract infections (Haque, Sartelli, McKimm, & Bakar, 2018). The fundamental objectives of the public and private healthcare in the ongoing COVID-19 global pandemic is to guarantee that all infected individuals get well from their ailments as quickly as possible (Moghadas et al., 2020). At times, infections become highly complicated as the healthy individuals get infected in the process within the healthcare centres including doctors and nurses who actually are the potential healthcare givers. The incidence and the undesirable consequences of hospital acquired infections have been acknowledged over several years and the trend had persisted at terrifying rate causing several complications within the global healthcare sector (Yang et al., 2020). The HAIs constituted a severe global public health risk, producing unimaginable death of about 1.4

million individuals across the globe at certain point (Abdellatif et al., 2007). The scourge of the HAIs frequently multiplies the healthcare expenditures on both patients, health services providers and the government (D. M. Anderson et al., 2020). The comprehensiveness of the financial encumbrance of HAIs throughout the United Kingdom (UK) hospitals and other healthcare providers is very hard to determine, however the contemporary assessment published in in the year 2000 recommended that the annual cost of HAIs in the UK was almost £1 billion (Head, Fitchett, Holmes, & Atun, 2014). In the same manner, several HAIs are actually preventable as it has been demonstrated that conformity to the general regulations significantly diminishes both the rate and proportion of the contaminations.

The WHO researches and other fine grain investigations have established that the highest occurrences of hospital acquired infections occurred in the intensive care units (ICU) and in acute surgical and orthopaedic wards (Lizioli et al., 2003). The Nosocomial infections usually add to practical incapacity and emotional anxiety of patients which potentially may lead to disabling conditions that condense the eminence of society life expectancy. The Nosocomial infections are among the prominent causes of death in the hospital (Ben Carter et al., 2020), in addition to overburden economic expenditures associated with the healthcare maintenances. However, the HAIs had contributed to uneven disproportionality involving resource allocation for primary and secondary healthcare delivery through diversion of meagre finances to the management of possibly avoidable health risk. There are several factors blameable to the continuous intensification of HAIs among the hospitalized patients and other individual within the healthcare facilities. Those factors include; (i.) Exceedingly old age (ii.) Poor immunity status of patients (iii) Clinical procedures and/or invasive techniques/devices (iv.) Development of drug-resistant bacteria (v.) Over-crowding within the healthcare facility (Saka, Saka, & Adebara, 2011). Usually, a very ineffective infection control measures may be attributable to the rapid transmission of the HAIs (Magiorakos et al., 2017). Findings revealed that personal hygiene, hand washing, knowledge of risky practices, education, proper food hygienic preparations, immunization, breast-feeding, collaboration with public health representatives in the event of pandemic eruption and disruption of focal-oral spread are all indispensable procedures for suppression of HAIs with regard to COVID-19 pandemic (Chan et al., 2020). The consequences of HAIs affect mutually the developing and developed countries of the world and that amounted to the general outcome of deaths and progressive morbidity among hospitalized patients. The demand to prevent the escalation of the COVID-19 pandemic and to safeguard the health of all citizens, patients and healthcare workers within the medical facilities should be considered paramount (Driggin et al., 2020). On a one particular event, the COVID-19 screening were carried out and preventive measures were taken on each of the women who were on admission for labour and child delivery (Boelig et al., 2020). Under these prevailing circumstances, the healthcare workers usually adhere to distinctive infectious deterrence techniques which include wearing of personal protective equipment (PPE), keeping of social distancing, and the use of sanitizer and avoid touching certain sensitive areas.

Based on the women COVID-19 assessment information, they may be attended in a negative pressure room in accordance to COVID-19 global pandemic guidelines with respect to child deliveries (Poon et al., 2020). Several healthcare centres potentially followed the pre-COVID-19 hospital management routine schedules in maintaining fewer obstructive visitor policies whenever they feel is safe and sound to follow the procedure. In this study, one university teaching hospital and one COVID-19 designated isolation centre were investigated. The hospital emergency departments and COVID-19 isolation centres were accommodative and accessible to provide protected emergency and essential care to the patients on the regular basis. The healthcare centres were able to offer in-person appointments and telecommuting services to a very magnanimous number of patients within and out of the healthcare facilities in the ongoing COVID-19 pandemic health management. Whenever there are medical issues including treatment for chronic ailments, comprehensive wellness assessments, screenings and lab tests, calls are usually placed on doctor's office who will readily determine if an in-person appointment or telecommuting options are most suitable for the needed care. For the in-patients appointment and treatments, all the patients were tested for COVID-19 infection before the hospital admittance within 48 to 72 hours preceding the surgery or clinical procedures (Al-Shamsi et al., 2020). However, the in-patients dwelling in the hospital are advised to come along with their digital devices, like laptop computers, mobile devices, or tablet, so as to digitally link up virtually with their family members and friends. This approach substantially placed a demand on the IoT connectivity and justification for the adoption of the health information communication technology in the ongoing society digital extreme automation. The current research was structurally organized into introduction, aims and objective of the study, statement of problem, literature review, research design and methodology, research implementation, analysis of research findings, discussion, limitations of the study, future research focus, recommendation and conclusion.

2. AIMS AND OBJECTIVES OF THE STUDY

The primary focus of the current research paper is to present the state-of-the-art biomedical application from the in-depth study of UV light device disinfection mechanism for healthcare applications. The subjects treated alongside UV light as a disinfecting agent, its healthcare practical applications include HAIs, IoT and 5G wireless network. The paper analyzed the use of autonomous IoT 5G UV device for comprehensive hospital disinfection as panacea to HAIs complications. The research proposed an adoption of IoT 5G UV device as safer and cost-effective approaches to hospital interior disinfection routine. Therefore, IoT 5G UV device were viewed as follows:

1. They can save lives through condensing pathogenic influences and bacterial infection within the healthcare facilities.
2. The health technology appraisal of the usefulness and budget impression of portable IoT 5G UV light disinfecting device for diminishing HAIs are scalable.
3. IoT 5G UV device installation can contribute to safe infrastructure maintenance and technology transfer management with respect to 5G inspired biomedical computing.
4. IoT 5G UV device microorganism surveillance captures specific targets which might be environment susceptibility.
5. The traditional practice of diminishing infections prevalence is through decontamination of patient rooms via labor-intensive clean-up. In the current research, a portable autonomous IoT 5G UV device installation was proposed to supplement (probably replace out rightly) the current manual hospital disinfecting operations.

3. STATEMENT OF PROBLEM AND RESEARCH QUESTIONS

In the ongoing development, the COVID-19 pandemic presented a healthcare emergency situation which is very novel to the world, leading to severe health and medical complications that tend to overwhelm the global healthcare manageability. In that regard, the Centres for Disease Control and Prevention (CDC) had announced that approximately 2 million people had contacted HAIs within the overcrowded health centres (Del Rio, Malani, & Omer, 2021). Among the leading possibilities of contacting infection is being hospitalized, as treatment in the medical care or hospital facility can increase the chances of contacting infection (Kim et al., 2021). Usually, the conventional technique of condensing and stopping the infections is sanitization of patient rooms through labour-intensive scrubbing and disinfecting the interior spaces. The portable UV light device systems are proposed to complement the current hospital disinfection techniques, together with its scalable budget implications. The current research reviewed several published scholarly articles on UV light device disinfection technology to arrive at its final submission. The approach yielded 15 peer-reviewed clinical publications that matched the eligibility conditions for UV disinfection techniques. Four reviewed publications focused on the mercury UV based technology, four articles relied on pulsed xenon UV technology while the remaining seven publications relied on UV light emitting diode irradiation. The applicability of autonomous IoT 5G UV device disinfection installations were established as to supplement the labour-intensive disinfection procedures in combating HAIs in the healthcare centres to condense the prevalence of HAIs. The research proposed an autonomous 5G IoT enabled UV light device for hospital disinfection which is expected to outperform the previous UV devices already in existence due to the device 5G network and IoT enablement, as the device can be controlled remotely through switchable synchronization. The UV light device can disinfect hard to reach places and that can assist hospitals globally to combat the spread of harmful microorganisms within the healthcare facilities.

In a study conducted and published by the American Journal of Infection Control (AJIC) where the microbial burden on objects inside and outside of the environments were measured pre- and post-chemical disinfection, the UV light device was used to condensed the active microbial burden by 92% to 97.7% prior to and in-between disinfection cases. The UV light device also lowered the microbial burden on objects outside prior to chemical disinfection with 96.3% to 99.6% effectiveness. (Armellino, Walsh, Petraitis, & Kowalski, 2019)

As a matter of fact, the following research questions has been put forward to guide the outcome of the research:

1. What is the applicability of autonomous IoTs 5G UV device disinfection installations as to supplement the labour-intensive disinfection procedures in combating HAIs in the healthcare centres?
2. Where the tests conducted in microbiology labs regarding UV light showed that the rate of kill of microbial pathogens were done under tightly controlled conditions?
3. On the environmental effectiveness tests, where the hospital rooms adjusted before and after UV device treatment?
4. On the clinical outcomes, where reduction in infection rates resulting from UV device usage calculated?
5. Do the UV germicidal lamps used in hospital system disinfection and many other sterilization applications have any potential damages to human health?

4. LITERATURE REVIEW

The ultimate goal of Global Health Security Agenda (GHSA) is to ensure that the CDC corporates with countries of the world to support public healthcare systems and control epidemics at the source, prior to uncontrollable escalation into regional pandemics or global bubonic plague (Standley, Sorrell, Kornblet, Fischer, & Katz, 2015). The public health hazards, health emergencies and communicable diseases do not distinguish the continental boundaries, to that effect, the effective public health surveillance in all countries diminishes the possibilities of global health terrorisations. From the broader perspective, the HAIs may also be contemplated as endemic or epidemic (Nekkab, Astagneau, Temime, & Crepey, 2017). The HAIs otherwise known as “Nosocomial infections” are among the infections contacted within the hospital or healthcare facilities which appeared first within the 48hrs or beyond following hospital admission or within 30 days after discharge from the outpatient care unit (OPCU)(Revelas, 2012). The HAIs suggested all infections that patients acquired while in the hospital premises which were neither existing nor breeding as at the time the patients were received in the hospital wards (Ontario, 2018). According to (Torres et al., 2017), there exist at least 10% Canadian adults on short-term hospitalization having HAIs which demanded that individuals responsible for healthcare management should consult other sources of relevant information, to appraise suitable patient’s health condition and to verify rules and regulations applicable to drugs and devices at the instances of prescriptions. Such developments are unconnected to the initial health conditions that brought the patients to the hospital and neither existing nor developing as at the moment of the hospital admittance. More than a few reasons exist why HAIs are alarmingly prevalent in the ongoing COVID-19 global pandemic. According to (Revelas, 2012),the factors that potentially promote HAIs within the twenty first century healthcare system include; (i.) Pattern of the hospitals building (ii.) oversized number of populations who are on admission (sick) and whose body immune system are often very weak to resist pathogens (iii.) Intensified outpatient treatment significance, which implies that individuals who are on admission in the hospitals are sicker when thoroughly evaluated (iv.) Healthcare personnel or medical staff interchanges from patient to patient thus increasing the chances for the pathogens to spread easily (v.)Unsatisfactory sanitation and hospital disinfecting protocols taking into account the uniformity of equipment sterilization and disinfecting high sensitive touch areas (vi) Sanitization, washing and other precautionary procedures that may either be overlooked by hospital personnel or too negligent to appropriately quarantine patients from the potential infectious agents (vii) Routine utilization and adoption of anti-microbial agents in the healthcare facilities to adequately generate selection pressure for the emergence of the resistant strains of microorganisms.

The HAIs take place in both adult and paediatric patients (Zingg et al., 2017). The bloodstream infections, alongside pneumonia and urinary tract infections are among the commonest healthcare associated infections in children while urinary tract infections and surgical site infections are among the simplest healthcare associated infections in adults (Haque et al., 2018). In understanding the risk associated with contracting COVID-19 in the hospital and interpreting the exact scenario of such cases in relation to the proportion of all hospitalised COVID-19 patients that were already diagnosed after 14 days hospital stays, the current research do not comprehend if those patients with HAIs who died did so as a result of the COVID-19 infection or of the initial ailment that kept them in the hospital. The prolonged hospital exposure increases the susceptibility of HAIs in addition to high possibility of mortality which suggest that outright deterrence could be the ideal solution to prevention of Covid-19 infection (Hendaus & Jomha, 2020). Although, it is possible that most community acquired COVID-19 cases died of the coronavirus complications (Kobayashi et al., 2020). Our study discovered diminished HAIs incidences in patients hospitalized in the Teaching Hospital (our case study) during the COVID-19 eruption when juxtaposed with the events of the previous years, notwithstanding the comparable clinical severity imposed by the COVID-19 outbreak. Taking into account the imaginable correlation between reduced HAIs risk and compliance to rigorous decontamination approaches in the ongoing COVID-19, our investigation further highlights the obvious impressions of preventive measures, robotic technology adoption to continuously provide sterilization to all sensitive touch areas capable of harbouring pathogens using UV light and the use of personal protective equipment (PPE) within the hospitalized patients' care unit and overall hospital ward for effective management. The findings seemed exceptionally applicable when deliberating on the potentialities of the encumbrances of HAIs on the global healthcare system with respect to mortality and public healthcare budget expenditures (Cook et al., 2021).

According to (Iwasaki & Yang, 2020), the global virologists are desperately in search of clinical remedies with regard to early vaccines for effective therapies for the cure of severe acute respiratory syndrome coronavirus2 (SARS-CoV-2) to diminish the mounting economic predicament and loss of human life that are associated with the virus. The SARS-CoV-2 vaccines are already developed at extraordinary speed and presently at clinical trials (Wang, Peng, Xu, Cui, & Williams, 2020), as several others have started circulating. The current paper focussed principally on the key aspect of the current society healthcare digital automation to enable healthcare workforce to perform better and countries to recover quickly in lowering the prevalence of the hospital acquired infections and easy down the escalation of COVID-19 pandemic as many countries are preparing for the second phase lockdown (Kretchy, Asiedu-Danso, & Kretchy, 2021). The objectives are to inspire academia, practitioners, captains of industries and researchers who are innovative in disruptive technology domain to discover the state-of-the-art IoT solutions in combating the COVID-19 pandemic through the incorporation of IoT based smart solutions from the global perspective(Matthew et al., 2021). According to (Behar et al., 2020), IoT based industrial solution will be required for monitoring patient conditions in the self-isolation home, healthcare centres and in diagnosing the COVID-19 pandemic based on IoT mobile phone data collection and analytics. While the current global world had intensified the struggles to defeat the ongoing COVID-19 pandemic, the second wave of the bubonic plague will be imminent and severe (Bontempi, 2020). As a matter of fact, defeating COVID-19 pandemic will require researchers from all works of life, together with information communication technologies (ICTs) experts, healthcare robotic innovations and IoT to provide the state-of-art solutions, capable of comprehensive management of the ongoing global health challenges (Elavarasan & Pugazhendhi, 2020).

In an attempt to contend with the growing trend of the HAIs, the current paper proposed adoption of autonomous 5G IoT UV light irradiation device to enable reduction of infections that patients contact while in the healthcare environment like outpatient clinic, community health centre, emergency department and physicians' offices. Those ill-health conditions were neither present nor developing as at the time the patient were received in the hospital operating environment which occurs 48hours to 72hours immediately after the hospital admittance or if those symptoms begins to manifest within 10 days following hospital discharge (Bush et al., 2015). The HAIs could be caused by a range of microorganisms including viruses, fungi or bacteria that are present in the hospital operating surroundings. The proposed UV device according to (Diab-El Schahawi et al., 2021), is the UV germicidal irradiation that utilizes short-wavelength to kill microorganisms by destroying their deoxyribonucleic acid (DNA) and ribonucleic(RN) leaving them incapacitated from performing any vital cellular functions within the healthcare facilities. In the conventional disinfection procedure, despite all efforts to sterilize hospital rooms and equipment, patients still acquire infections from their stay in the hospital (Diab-El Schahawi et al., 2021). The Centres for Disease Control and Prevention had reported that one in 31 patients in a hospital will acquire at least one HAIs each day (Page et al., 2021). In a related development, nearly 1.7 million patients annually contract infections while being treated for another health issue, with estimated 98,000, one in 17 dying from the HAIs complications (Diab-El Schahawi et al., 2021). The proposed UV light disinfection utilized in the hospitals are proven to reduce harmful pathogenic influences including some of the most dangerous microorganisms (Ezeuko, Ojemaye, Okoh, & Okoh, 2021). The UV light wavelength at 254nm is proven to eliminate even the toughest of supergerms and is assisting hospitals to condense the escalation of HAIs (Diab-El Schahawi et al., 2021). The UV light disinfection is proven to successfully condense the spread of disease in hospitals when used in combination with the standard manual clean-up procedures and is also independent of labour-intensive cleaning activities. The UV light can disinfect hard to reach places and that had assisted hospitals globally to combat the spread of harmful microorganisms within the healthcare facilities (McGinn et al., 2020).

In a study conducted and published by the American Journal of Infection Control (AJIC) where the microbial burden on objects inside and outside of the environments were measured pre- and post-chemical disinfection, the UV light device was used to condensed the active microbial burden by 92% to 97.7% prior to and in-between disinfection cases. The UV light device also lowered the microbial burden on objects outside prior to chemical disinfection with 96.3% to 99.6% effectiveness. (Armellino et al., 2019)

5. RESEARCH DESIGN AND METHODOLOGY

Participants of the current research study were basically the healthcare professionals, among whom are: (i.) Medical doctors (ii.) Pharmacists (iii.) Nurses (iv) Medical Laboratory scientists and (v.) COVID-19 ad hoc volunteers. Those participants were selected proportionately on the premise of their job distribution within the healthcare sector especially in the ongoing COVID-19 global pandemic.

Their involvement was very significant on the account that they were presumed to have adequate knowledge of the infections than any other person due to their expansive training on health-related developments. The instrument for data collection and sampling methodology were modified pre-validated questionnaires. Modifying the questionnaire is important when the survey is already in the field. Therefore, the survey solutions will treat any modifications of the questionnaire as a new survey. The measurement of the occurrence of HAIs was done through questionnaire and expressive interviews to discover the infections the study participants have contended within the course of their professional/ occupational activities and to assess the questions describing the prevalence of HAIs in relation to the underlying components of universal preventative measures. The questionnaires were distributed to the participants working in: (i.) Intensive care unit (ii.) The theatre (iii.) The medical (iv) Surgical and/or Gynaecology (v) Neonatal and/or Paediatrics wards (vi) Chemical pathology(vii) Bacteriology and/or Parasitology (viii) Blood bank and/or Haematology (ix)Histopathology laboratories (x)The HIV care unit (xi) Dispensing /Pharmacy units.

The reason behind choosing those units were on the identified higher possibility of encountering HAIs within the environment. The data sample were the patients hospitalized in the neonatal intensive care units (NICUs) which provide care for newborn infants. Paediatric intensive care units (PICUs) which provide care for children and outpatient department (OPD) which provided diagnosis and care for patients that are not required to spend a night in the Teaching Hospital (case study) from May 8, 2020, to July 31, 2020, were all together studied (study group) and contrasted with hospitalized patients during the exact period in 2019 (control group). The NICUs and PICU that always contain a total of 44 beds were marked as COVID-19 pandemic free from the commencement of the epidemic as the number of the available beds were restricted to 26 bed spaces. Immediately the healthcare sector received the news of the coronavirus spreading, the Nigeria Centre for Disease Control (NCDC) in collaboration with the Federal Ministry of Health quickly put guidelines for the new healthcare COVID-19 adjustment. Subsequently, the hygienic measures were adopted in our case study which led to: All healthcare workers methodically adopting protective face masks or surgical protectives depending on whether the contact with patients were either direct or indirect. All patients were wearing a surgical mask during the hospital consultations, wearing of hand gloves and safety goggles for eye protection, enforcement of at least 1.5 m distance between hospital beds.

The investigation accommodated patients who came directly from the emergency ward and excluded patients transferred to the selected unit from wards other than the emergency ward. The investigation provided the ample opportunities to assess the impression of the intensified PPE use without compromising the effects of SARS-CoV-2 and any possible HAIs. The research gathered demographic information, knowledge regarding medical comorbidities (comorbidity explains the prevalence of all other situations an individual patient could possibly have other than the most important circumstances worthy of consideration which could be psychological or physiological), the interval and reason for hospitalization, amount of invasive devices (nasogastric tubes, peripheral venous line, urinary catheter, central venous line etc.), the amount of recommended antibiotics, incidences and number of HAIs. The study indicated that antibiotic prophylaxis usage was not associated with any patient in both duration and no antibiotic was recommended in advance. The antimicrobial prophylaxis is generally utilized by the clinicians for the prevention of plenteous contagious diseases such as rheumatic fever, herpes simplex infection, meningococcal disease, spontaneous bacterial peritonitis in patients with cirrhosis, recurrent uncomplicated urinary tract infections in women, recurrent cellulitis, influenza, infective endocarditis, acute necrotizing pancreatitis and pertussis, together with infections accompanying open fractures, bite wounds and recent prosthetic joint placement (Enzler, Berbari, & Osmon, 2011). The most important attribution of our investigation was to evaluate any imaginable differentiations in HAIs and antibiotic prescriptions between the study group patients hospitalized within the period under review and control group patients hospitalized during the same period in 2019 when the COVID-19 pandemic was not known. On this note, our investigation realized decrease in HAIs episode in patients hospitalized in the investigated units during the COVID-19 eruption when juxtaposed with the previous year, notwithstanding the relative clinical severity. Taking into consideration the possible correlation between the diminished HAIs risk and adherence to stringent hygienic procedures as result of COVID-19 induced precautionary. Our observation highlights the excessive impression on counteractive procedures, comprising the use of PPE on hospitalized patients' care and management. However, the research findings highlight outstandingly the burden of HAIs on the Nigeria healthcare system with respect to public budget expenditures and mortality and finally proposed measures for combating hospital acquired infections within the healthcare facilities in anticipation to zero HAIs circumspections.

On the implementation of the UV light device for the hospital disinfection, the current research reviewed several published scholarly articles on UV light device disinfection technology to arrive at its final submission. The review yielded 15 peer-reviewed clinical publications that matched the eligibility requirements. Four reviewed publications focused on mercury UV based technology, four articles relied on pulsed xenon UV technology while the remaining seven publications relied on UV light emitting diodes irradiation. However, findings were either the device produced very low-quality evidence, or the intervention was effective in reducing the rate of the combined outcome of HAIs, but none was autonomous in nature or IoT enabled. On the other hand, there exist strong evidences that UV light irradiation when properly utilized have the capability to condense the spread of disease causing organisms in the hospital(Browne, 2021). In the current research, the mission for autonomous 5G IoT enabled UV light device for hospital disinfection is expected to outperform the previous UV already in existence due to the device 5G network and IoT infrastructure enablement as the devices can be controlled remotely through switchable synchronization. The proposed UV–C light emitting diodes (UV-C LEDs) is a newly emerging UV-C light source with a potential to replace any conventional chemical methods with respect to mercury UV lamps and xenon lamps disinfection(Nyangaresi et al., 2019). The UV-C LEDs are symbolised by the multiplicity of wavelengths that can be turned on and off with a high and switchable frequency gauge, making them a delightful options for pulsed light disinfection apart from the conventional continuous wave operation. The existing literature that compared the Mercury UV lamps, Xenon UV lamps and UV-C LED irradiations for the inactivation of pathogens in the hospital disinfection routine are limited to some extend and results conflicting(Bhardwaj et al., 2021). In the current paper, the UV-C LED irradiations were implemented and study proved that UV-C LED disinfection technology is user and environmental friendly as it eliminates up to 97.7 percent of pathogens in the hospital operating rooms(Steele et al., 2021). The current research analysed all the 15 existing literature that discussed UV technology and its effectiveness and finally proposed the installation of autonomous 5G IoT UV-C LED as the most current and updated contribution in the subject of UV light disinfection technology.

6. PORTABLE UV-C LIGHT EMITTING DIODE (LED)

The portable UV-C LEDs have opened up a new set of user safety experiences around the healthcare occupational settings, at the rightful moment when innovative paradigm shifts are desperately demanded- (Zissis & Bertoldi, 2018). In addition of being a healthcare security corridor, the UV-C LEDs maintained a high-radiance operations, compact, solid-state emitters that keep under control all unique toolkit for developing safe and effective solutions not only for healthcare surface environments disinfection, air, water, food safety and protection of office workers, shopping malls and commuters in the post-COVID-19 global occupational space (Kreitenberg & Martinello, 2021). The UV-C LEDs are automatic disinfecting robot-like systems that are utilized to kill pathogens responsible for infectious diseases especially infections contacted within the hospital environment (Geldert et al., 2021). The UV-LED devices operates predominantly through the use of lamps that produce high intensity ultraviolet irradiation, a form of electromagnetic radiation UV-C wavelengths of 100nm–280nm on the electromagnetic spectrum (Cassar, Ouyang, Krishnamurthy, & Demirci, 2020). The UV-C LEDs germicidal irradiation is the decontamination approach that required the utilization of the short-wavelength ultraviolet light to incapacitate microorganisms by annihilating their nucleic acids and disordering their DNA, leaving them incapable of performing any useful cellular activities. The adoption of Ultraviolet light disinfecting devices are not usually premeditated to replace out rightly other environmental cleaning exercises but to complement them in the most smartest manner with respect to industry 4.0 extreme healthcare automation (Matthew et al., 2021). The current research took notice of three types of portable UV devices for surface disinfection already in existence which include those that emit a continuous dose of UV-C light through a mercury bulb, those that utilize a pulsed xenon light and those that use UV-C LEDs. In establishing the research line through the in-depth study of the three UV light devices from the existing literature, the current research discovered the potential shortcomings of the Mercury UV–C devices and pulsed xenon UV-C devices that made them less efficient to be considered the standard disinfecting prerequisites. According to (D. J. Anderson et al., 2017), the evidence of the mercury UV-C performances was assessed as low quality because the relative reduction of combined hospital acquired infection (vancomycin-resistant enterococci) and colonization rates among patients disinfected with mercury UV-C devices when compared with the standard manual disinfection, does not show any significant improvement. In a similar development, the research conducted by (Jiang et al., 2021), proved that certain number of UV-C lamps containing mercury are associated with problems because mercury is toxic even in small amounts in addition to photo degradation due to its high energy consumption.

According to (Ontario, 2018), there are several variations of mercury UV-C devices in existence with different numbers of lamps used and the type of output produced are varied in relation to standard or maximum-output mercury lamps. On the other hand, the Mercury UV-C devices utilized low-pressure mercury gas bulbs that predominantly radiate a strong narrow band of the UV-C spectrum in the range of 254 nm that targeted some specific type of bacteria on the surfaces that are not on generic specifications. The Pulsed xenon UV devices utilize xenon lamps to produce a flash of full germicidal light across the entire disinfecting spectrum at the wavelengths of 200nm–320 nm, including both UV-C and UV-B category spectrum. The major problems associated with xenon UV devices especially UV-B category include skin cancer (melanoma and no melanoma), premature aging and other skin damages, cataracts and other eyes effects and immune system suppression (Knuschke, 2020). The device is designed to operate in the absence of human contacts, because its operating rooms must be vacated and doors must be shut during the disinfection process as the device sensors will automatically stop the irradiation if the door is opened or any other bodily movements are perceived (Ontario, 2018).

Table 1 in particular, highlighted the prominence of ultraviolet germicidal irradiation (UVGI) specifically for UV-C LEDs for surface, air, water, food disinfection and hospital operating environment, well recognized by researchers, pointing to the potential benefits of a compact, high-intensity, solid-state UV-C LEDs radiation. In the ongoing development, the UV-C LEDs technology was perceived to be a well-focused visible light communications and robust compound semiconductor material systems, unambiguously appropriate for the efficient generation of blue light, the primary light source necessary to enable full color solid-state lighting which had completely revolutionize lighting and displays technologies (Tian et al., 2021).

7. RESEARCH IMPLEMENTATION

The current research was a conception from the ongoing COVID-19 global pandemic to fashion an innovative technology paradigm required for the current society extreme digital healthcare automation. The research was designed to enable a high command technology innovation that will address the key aspect of the current society healthcare challenges, relying on the *Implementation of automated hospital disinfection procedure using autonomous 5G IoT UV light device to kill pathogens responsible for hospital acquired infections, which contribute to death of patients and add to the healthcare budget expenditures from time to time.* To support the above technology implementation, this research

Table 1. Scholarly evidential proves of the performances of UV-LEDs as the best ultraviolet light irradiation in the public places like hospitals

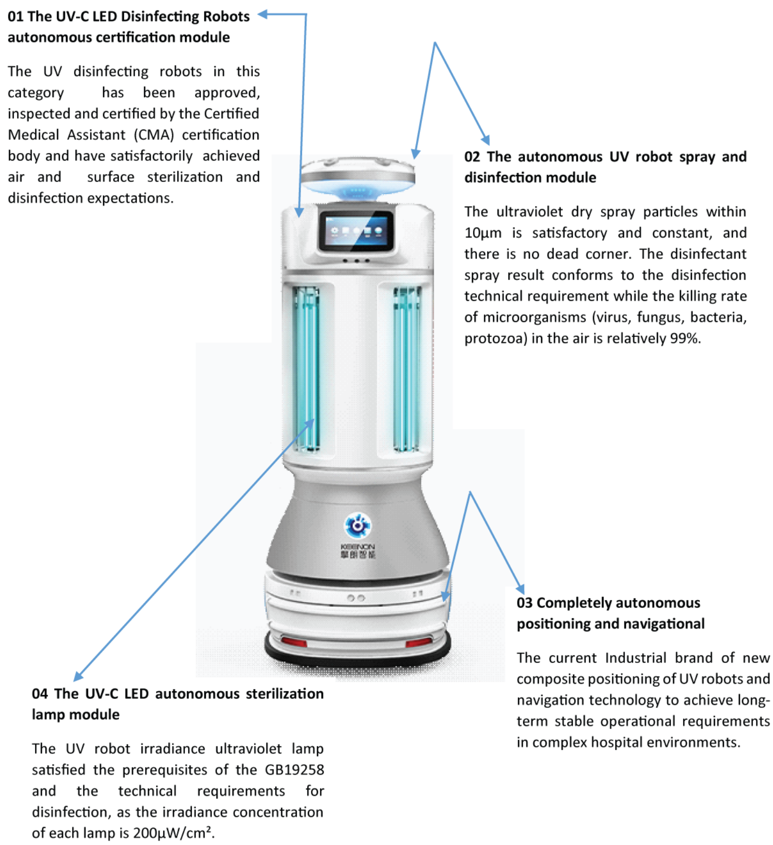
Author and Year	Article Publication	Significant Findings
(Zissis, Bertoldi, & Serrenho, 2021)	*Publications Office of the European Union: Luxembourg.*	1. The solid-state lightings based on constituents like LEDs, organic light-emitting diodes (OLEDs) and laser diodes (LDs) are challenging the conventional technologies, particularly, the LED which had turned into a technology game changer beating all conventional technologies on every aspect. 2. The phosphorous converted White LEDs (pcW-LEDs) have played several significant roles in the modern lighting technology, because their high efficiency and luminous effectiveness have made them appropriate alternatives for both conventional and specialized lighting sources. 3. The visual light communications utilize the LED beam to deliver data communication signals.
(Weber, Kanamori, & Rutala, 2016)	*Current opinion in infectious diseases, 29*(4), 424-431	4. The ultraviolet (UV) light devices, hydrogen peroxide systems, and self-disinfecting surfaces were used to reduce healthcare-associated infections. 5. Disinfection of the infected patients' rooms with nosocomial pathogens including methicillin-resistant Staphylococcus aureus, vancomycin-resistant Enterococcus spp., Clostridium difficile, Acinetobacter spp., and norovirus were completely disinfected with UV-LEDs.
(Wan et al., 2020)	*Water research, 173*, 115553.	6. The research provided abundant and advantageous information for the reasonable exploitation of UV-LEDs in water disinfection. 7. The results indicated that the implementations of UV-LEDs were superior for the inactivation of fungal spores compared to other UV-C devices. 8. The Ultraviolet light emitting diodes (UV-LEDs) were considered as a potential alternative to conventional mercury lamps for water disinfection to treat waterborne species (Aspergillus niger, Penicillium polonicum and Trichoderma harzianum) at a batch water disinfection system.
(Sumathi, 2021)	*ECS Journal of Solid State Science and Technology, 10*(3), 035001.	9. The high UV transparency unique property is essential in the development of UV-C LEDs when aluminium nitride (AlN)-based high-power LEDs emitting in the 240nm to 280nm range are used which have the potential to completely replace the Mercury lamps in surface disinfection. 10. Mercury UV-C gas discharge lamps causes serious health risks due to its toxicity in case of lamp breakages while the semiconductor solid-state light-emitting diodes (UV-C LEDs) when juxtaposed with the normal gas light sources are: highly reliable,, non-toxic, high luminescence efficiency, miniaturized small size form, robust, low maintenance cost, portable and do not produce any harmful by-products. 11. The germicidal efficiency of high-power UV LEDs, operating in the wavelength range of 240nm–280nm, against MRSA, E. coli and a variety of pathogens have been efficiently disinfected and sterilised.
(Ragusa et al., 2020)	*Eastern Journal of Medicine, 25*(3), 330-339.	12. The paper reported a reduction in the bacterial load in 70% of the cases after using the UV-C LED device in the hospital disinfection. 13. The UV-C LED possessed double control system – mechanical sensors and optical– to be utilized under operational safety environments, with a microprocessor for irradiation and security controls. 14. The UV-C LED disinfection devices are profitable when contrasted with the other families of UV-C devices due to its electrically rechargeable capability.
(Ploydaeng, Rajatanavin, & Rattanakaemakorn, 2021)	*Photodermatology, Photoimmunology & Photomedicine, 37*(1), 12-19.	15. The UV-C LED 16watt and 18watt were confirmed to have meaningfully reduced the colony forming unit (CFU) of Pseudomonas aeruginosa, Staphylococcus aureus and Escherichia coli on the stethoscope membrane after more than 240 hours and 2900 cycles of use.
(Armellino et al., 2019)	*American journal of infection control, 47*(4), 409-414.	16. *Microbial burden on objects inside and outside of the environments were measured pre- and post-chemical disinfection, the UV light device was used to condensed the active microbial burden by 92% to 97.7% prior to and in-between disinfection cases.* 17. *The UV light device also lowered the microbial burden on objects outside prior to chemical disinfection with 96.3% to 99.6% effectiveness.* 18. *The device yielded considerable overall diminutions of the microbial burden on patientcare apparatus in all study phases without alignment on manual cleaning and chemical disinfection within the hospital environment.*

made an expressive demand for non-standalone (NSA) 5G network technology, the fifth-generation cellular wireless technology that has the capacity for enormous connectivity power and high-speed for transforming healthcare sector service delivery. The 5G network infrastructures possessed the capacity and sustainable potentials for transforming the internet of health hings (Hatzivasilis et al., 2019), to empower medical innovations to utilize robotic system interactivity (Le, Van Le, Tromp, & Nguyen, 2018). The 5G network technology, will necessitate success for robotic applications and smart interactive systems for disease surveillances. The Multi-Access Edge Computing (MEC) and several other innovative network associated technologies would be utilized to recreate, remodelled and automate hospital undertakings while improving patient care, staff experiences and returns on the investment (Cynthia Davis & Stoots, 2013). The 5G network technology will ensure sustainability in: (i.) Technology transfer and technology driven patient rehabilitations, treatments, and recovery through remote monitoring in ongoing healthcare development as the hospital facilities are overstretched in the recent time owing to the devastating effects of COVID-19 pandemic (ii.) Service reworking through artificial intelligence (AI) robotics technologies to enable healthcare operative logistics (iii.) Transmission of enormous sensor scanned image records (iv) Healthcare resources conservation and efficient management.

The current research was inspired by the prevalence of COVID-19 global pandemic and effects of hospital acquired infections and its potential risks to the global healthcare sectors, in addition to yearly budget expenditures. The research proposed the adoption of the innovative robotic technology that utilizes UV light to disinfect neonatal intensive care units (NICUs) which provide care for newborn infants. The paediatric intensive care units (PICUs) which provide care for children and coronary care and cardiothoracic units (CCUs/CTUs) where treatments are carried out based on the current study. The utilization of scientifically certified UV germicidal irradiation (UVGI) technology to kill hospital pathogens and prevent them from spreading is scalable (Ontiveros et al., 2020). The UV disinfecting robot is IoT enabled with 5G network connectivity support, controlled through the cloud infrastructure for operational synchronism (Zhu, Wang, & Zhang, 2020). However, a minimal manual cleaning may still be possible while the robot handles the room disinfection as this procedure will equip the healthcare sector utilization and improve workflow. The UV sterilization and disinfection robot according to Figure 1 will readily exterminates germs in the healthcare operating environment through decomposing the DNA structures of the pathogens, in this manner preventing the spread of microbes, bacteria, viruses and other diseases causing microorganisms responsible for hospital acquired infections. The fundamental aspect of the UV disinfection and sterilization procedure requires condensation of the ultraviolet beams into an emitting dispersion to kill bacteria and other harmful microorganisms with a disinfection rate of 99% accomplishments (Plazas Tuttle, 2017).

According to Figure 1, the automated UV robot is capable of successfully killing microorganisms in the air such as viruses, fungi, bacteria, and other harmful microbes. The 5G wireless IoT autonomous robot for disinfection and sterilization had set of predetermined activities having proficiencies in autonomous operation and automatic charging therefore guaranteeing continuance mobility and predefined routine operations. Referring to Figure 1, the UV Robot is an interior walkable smart and autonomous IoT enabled, conceived for internal virus, bacteria, fungus in addition to microbial prevention within the healthcare facilities to lower the prevalence of the hospital acquired infections especially in the ongoing COVID-19 where the hospital are overcrowded(Kaiser, Al Mamun, Mahmud, & Tania, 2020). The 5G UV-C LED IoT disinfecting robot is furnished with cutting-edge technological innovation that allows it to traverse autonomously, producing short-wave UV light and spontaneously spraying disinfectant beams within interior spaces of the hospital wards. At present, several organizations have adopted UV disinfecting robots as one of the ultimate robotic solutions to combat the spreading of the contemporary COVID-19 pandemic in the healthcare centres with varying specifications. The UV Robot is provided with a short-wave lamp system to fill a single-cycle, whole-room disinfection. The UV autonomous disinfecting robot wavelengths are usually within the range of 200nm and 300nms, making them germicidal which implies that they are proficient in

Figure 1. The 5G IoT UV-C LED Autonomous Robot for Hospital Disinfection and Sterilization



incapacitating microorganisms, like protozoa, viruses and bacteria from replicating(Zheng, Ahmad, & Abbasi, 2020). On this note, the UV-C LED disinfecting robots energy level are very effective, chemical-free and environmentally-friendly in a way to prevent microorganisms from multiplying in any environment especially within the healthcare facilities where the risk of hospital acquired infection are high.

Table 2 gives the operational description of the IoT UV-C LED robot module operation empowered for autonomous cross-floor disinfection and epidemic prevention services for lowering the scourge of HAIs in the ongoing COVID-19 global healthcare challenges.

8. RESEARCH FINDING AND ANALYSIS

The current study investigated the biomedical application of UV-C LED device utilization for the incapacitation of pathogenic microbes responsible for HAIs. Meanwhile, the overcrowding within the hospital ward, deficiency in infection control mechanism, shortages of trained infection control providers and insignificant attention to a system of comprehensive hygiene had been described as the causative circumstances to the transmission of hospital acquired infections (Sydnor & Perl, 2011). In this study, the most common procedure to hospital acquired infections prevention known to the participants were the use of conventional disinfection routine and PPE. The HAIs may be connected to the healthcare workers unintentionally transmitting the same infections to the vulnerable patients.

Table 2. Specifications of the UV autonomous IoT Robot for hospital disinfection

Size	*500*500*1350mm*	Maximum Speed	*0-0.8m/s*
Capacity	*15L*	Network Interface	*WIFI/5G/4G/Bluetooth*
Spray parameters	*The amount of spray is 2-4L/h, the spray substance is lower than 10μm*	Battery Life	*DC 48V 15Ah*
No. of ultrasonic atomization	*6sets of ultra-dry mist atomization*	Rated Power	*150W*
Applicable Disinfectant	*Hydrogen peroxide, hypochlorous acid*	Standby current	*<0.5A*
No. of UV groups	*4 short-wave UV –C LED lamp*	Standby time	*»24h*
UV irradiance intensity	*>200μW/cm^2*	Battery life	*»4h*
Product weight	*70kg*	Life span	varied

The sanitizing of hands was very indispensable in decreasing the possibilities of HAIs transmission in the ongoing practice. In the current study, the impression of hands sanitization among the healthcare workers was to ensure protection and limit the possibility for cross infection. However, the endorsement of hand sanitization observance in healthcare facilities are set of priorities and requirements for leadership, resource management and administrative support but that in its entirety does not stop HAIs on large scale (Abdellatif et al., 2007). The medical practitioners were safeguarding themselves and their patients through consistent and appropriate use of PPE while on duty in the absence of the proposed technology. The portable UV-C LEDs have opened up a new set of user safety experiences around the healthcare occupational settings, at the rightful moment when innovative paradigm shifts are desperately demanded (Zissis & Bertoldi, 2018). In addition of being a healthcare security corridor, the UV-C LEDs maintained a high-radiance operations, compact, solid-state emitters that keep under control all unique toolkit for developing safe and effective solutions not only for healthcare surface environments disinfection, air, water, food safety and protection of office workers, shopping malls and commuters in the post-COVID-19 global occupational space (Kreitenberg & Martinello, 2021).

9. LIMITATION OF THE CURRENT RESEARCH

The COVID-19 indeed took the world by surprise but thanks to Made-in-China-2025 techno-innovative framework to have helped the world to exert disproportionate responses to the pandemic. On the other hand, the COVID-19 had enabled the world to open the front-line innovation and technology for emergence of digital colleagues (Robots) which played significant role in the fight against COVID-19 especially in China. The current digital society required several customized appliances, intelligent technologies, and intelligent sensitive lighting communication devices solid state lighting diodes. In the current paper, the researchers provided analysis of UV-C LED technologies and skills for the ongoing COVID-19 healthcare responses and proposed standards for the current generation healthcare digital automation and technologies that ought to accomplish the evolution of the current state of health technology innovations and evaluated how they corresponded to the upcoming medical and healthcare requirements. The UV-C LEDs technologies had accomplished extraordinary improvement in a miniaturized physical lighting communication. From the general perspective, UV-C LEDs from all indications contained essential prospect for the upcoming healthcare improvements as many efforts are still demanded to fill some gaps. However, UV-C LEDs technologies are still in its formation stage, together with the networked robotic mediated automation being an interesting development in its scientific contribution with cosmopolitan far-reaching implications in future healthcare management. This will pave way for improvement in accuracy for precision and resourcefulness for Internet of healthcare robots and Internet of 5G medical robots technologies in assisting surgeons, clinicians and physicians perform better which were traditionally not amenable techniques in the time past. To the same degree of perfections, the prospect for appropriate lighting medical technologies will be applicable to the expanded categories of procedures in clinical operations.

The concern for cost effectiveness regardless of whatever degree of technical sophiscation, the clinical performances should be addressed holistically from the expanded consultations and all issues should be answered technically before UV-C LED techniques can be transformed into conventional utilities in the routine healthcare and clinical establishments in all the health facilities in the developing countries where infrastructural deficits are prevalent. The technological innovations for the healthcare technology such as robotic and UV-C LEDs can be technically aligned along with internet of health things to construct a novel approaches for achievement and evaluation of the COVID-19 diseases treatment options by means of replicating all procedures that have worked in other countries who have recorded significant progresses.

10. FUTURE RESAERCH FOCUS

The UV-C LEDs irradiation technology may perhaps be a favourable instrument for healthcare facilities sterilization, particularly when the environmental means of transmission is well known as the hospital rooms and wards. The HAIs have pushed a momentous increment of morbidity and mortality among patients in the ongoing COVID-19. To that effect, the combined effort of the public health has focussed on averting the escalation of the infection through the adoption of environmental control measures. The adoption of UV-C LEDs irradiation or ultraviolet germicidal irradiation (UVGI) have brought interesting upgrade towards microorganism extermination. The vison for future healthcare conveyance, highlights the ability of UV-C LED irradiation in hospital disinfection procedures with respect to its application and safety in the medical field for comprehensive microbial elimination. The prevalence of COVID-19 pandemic which was triggered by SARS-CoV-2 has awaken the current society consciousness to the significance of UV-C LEDs which had generated compelling attentiveness in innovation in developing novel technology capabilities to combat bacterial, fungus and viral pathogenic prevalence using light irradiation. The current and future UV-C LED application development will have profound impact in transforming the global world into cleaner and safer environment void of pandemic and hospital acquired infection terrorization.

11. RESEARCH RECOMMENDATION

The Centre for Disease Control had reported that microorganisms and viruses have developed several resistance technicalities that empowers them to evade the effects of chemical, antimicrobials, and antivirals treatments. While the medical care has been expedited to administer in a wide range of options, there is equally a need for portable disinfection equipment installations to protect patients and clinicians from drug-resistant pathogens and life-threatening infections. To that effect, the installation of UVC LEDs will play a significant function in the development of next generation disinfection device technologies. The UVC LEDs will energize portable technology generation required for healthcare disinfection operations and extreme hospital automation. As the development of portable UV-C LED disinfection device takes the front technology burner, there are two most critical parameters required to be evaluated which include the dosage of the light source intensity (expressed as mW/cm^2) and the exposure or residence time/duration the microbe is exposed to the energy of UV-C LEDs. When the energy requirements of the UV-C LED are clearly understood, the UV-C LED sterilization device can be created to match even the smallest disinfection objective. As LED technology is advancing rapidly, the complementary medical device manufacturers are turning to deep-ultraviolet (D-UVC) light-emitting diodes (LEDs) towards creating a considerably smaller footprint and directional UV light in the optimal 250 nm to 280 nm wavelength range for comprehensive disinfection routine.

Finally, from the commencement of the COVID-19 pandemic, China covered up the existence of the virus from both its citizens and the world(Guo et al., 2020). However, the need to be transparent with such Public Health related issues is incontrovertible, indisputable, incontestable, undeniable, uncompromising and without shred of doubt. Country like Germany was transparent from the beginning of the outbreak as well and did not delay to take strict measures. They became one of the first countries to develop a reliable COVID-19 test pack in January 2020. They rolled out production soon after to reach the population quicker. In comparison, the Food and Drug Administration (FDA) in the U.S. delayed any proactive measures, allowing tests from large companies to manufacture their tests only in March 2020 leading to overall shortages(Piatek, Ning, & Touchette, 2020). The German chancellor, Angela Merkel, sent out strong, yet clear messages to the population to respect restrictions imposed so as to curb the spread. "This is serious," she said in her speech. "Since German unification not even since the second world war, no challenge to our nation has ever demanded such a degree of common and united action". The COVID-19 events are increasing at varied speed across countries and continents even in the United States of America, citizens were stocked amidst the countrywide public health catastrophe. Every single state encounters distinctive challenges and the situations for success story contrast to a great extent, focusing on the demography, public observance and the capability of healthcare specialists and health workforce to manage the gradual escalation in request for remedial care. While clinical tests surfaces, state executives will afford adoption of all-encompassing diversity of approaches studying developments from domestic and international encounter, taking account of proportionate implementation. Adopting those methods can impede the escalation of the corona virus with the assistance of medical specialists and the collaboration of the public. The struggles to defeat COVID-19 will be accomplished or probably eluded on the premise that government and local administrators have the obligation to mobilize and give directives while the federal government will provide supplies and provision towards comprehensive COVID-19 defeat. In personalising the approaches for adoption, governments at all levels should contemplate methods that have achieved results from the global perspective and integrate them into the national health recovery plan.

12. CONCLUSION

In this current paper, the pervasiveness of HAIs was reported in relation to UV-C LED light device adoption in the ongoing COVID-19 pandemic health risk management. Even though the healthcare workforces have comprehensive knowledge of HAIs, uncompromising response should be exerted in identifying and resolving the challenges posed by the health menace. Systematic surveillance of the HAIs is needed in order to condense hospital infectious spreading and improve the quality of life of patients and healthcare employees together with healthcare delivery system performances. The future healthcare system suggests an astounding opportunities, connecting humans and scientific innovations, which the current digital society believed will improve the level of healthcare solutions and performances of the Medicare in such manner that had not been witnessed or seen before. Interestingly, the ongoing COVID-19 pandemic heightened innovation on public health consciousness through disinfection techniques to condense the menace of HAIs. The proposed disinfection UV-C LED light device are promising tool for surface sanitization in the hospital with greater future potentials. In the current design, adjustments of hospitals and UV light devices are needed to overwhelm the challenges of movement constriction of the proposed 5G autonomous IoT UV-C LED light device for the hospital environment. At moment, the automated disinfection UV device do not replace entirely the routine sanitization but usually complement it. In time to come, they might provide validated, reproducible and well-known disinfection procedures. As already reported in the literature, in a study conducted and published by the American Journal of Infection Control (AJIC) where the microbial burden on objects inside and outside of the environments were measured pre- and post-chemical disinfection, the UV light device was used to condensed the active microbial burden by 92% to 97.7% prior to and in-between disinfection cases. The UV light device also lowered the microbial burden on objects outside prior to chemical disinfection with 96.3% to 99.6% effectiveness. The current paper reviewed 15 related biomedical literature that discussed the topic of hospital disinfection using UV device and reported its findings. The research questions have been ultimately answered together with all the factors that necessitated the proposed IoT UV-C LED installation. The research concluded that installation of autonomous IoT 5G UV-C LED device within the hospital facilities will provide means for infectious surveillance that will effectively control the menace of HAIs in the medical facilities in the ongoing COVID-19 as the susceptibility of HAIs are exceedingly high in the overcrowded healthcare centres.

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CONFLICT OF INTEREST

This piece of work does not have any conflicted of interest. The author declares no conflict of interest in preparing this article.

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