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# Infection Control Transmission at Mary Johnston Hospital: A descriptive randomized sampling of Medical Chart Cases as a potential carriers of hospital acquired infection, Isolation and identification of opportunistic and pathogenic organisms from different hospital ward units and a randomized controlled triple-blind trial of identifying a readily available and cost effective disinfecting agent for infection control

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## Abstract

**Background:** Health care associated infection (HAI) is a vital and a critical concern for clinicians, hospitalists, infectious control committee (IFC) and healthcare institutions in the Philippines. In a cross sectional prevalence study conducted by Godfera et al. In tertiary care hospitals of 224 patients surveyed 28% had HAI. Immune compromised patients, pediatrics, elderly and post op patients are at risk for acquiring HAI. Patient's medical chart cases in hospitals are potentially contaminated by pathogenic bacteria and might serve as reservoirs and vehicles for transmission of nosocomial infections.

**Objective:** To microbiologically analyze and identify the presence of bacterial contamination in hospital chart cases and compare the distribution of contributory pathogenic species from different ward and special units of Mary Johnston Hospital. This study was also conducted to determine a readily available and cost effective disinfecting agent that can be recommended to the Infection Control Committee (ICC), hospitals and other allied healthcare facilities to reduce the risk of Hospital Acquired infections contamination from chart cases surface to hands of Health care workers (HCW) to patient contact.

**Methodology:** Descriptive, randomized sampling randomized controlled triple-blind trial. Sample composed medical chart cases in direct contact with doctors, nurses and allied health care workers. Data were collected and analyzed using the SPSS statistical software package (Version 16.0, SPSS Inc, and Chicago, IL, USA). The statistics used in this study will included descriptive statistics, the chi-square ( $X^2$ ) test, the Fisher's exact test (for expected numbers <5) and the t test to compare differences in the characteristics and the results of identified and isolated bacteria retrieved from medical chart cases and effectively of disinfecting agent used against them.

**Results:** For general wards and special units, the overall sampling rates were 71.4 % (50/70) medical chart cases of currently active hospital beds out of 120 bed capacity of Mary Johnston Hospital. The randomized chart cases were comprised of 27% (10/37) Pedia, 33% (8/24) Obgyn, 31% (7/22) Medicine, 21% (5/21) Surgery, 100% (4/4) Covid 19 Clean ER, 100% (6/6) Covid 19 tent ER, 71% (10/14) Covid Ward. 100% Isolation and 11 bacteria were identified from culture positive chart cases, 45% were gram negative and 55% were gram positive.

Most common bacteria isolated was Bacillus spp. 78% followed by Coagulase- negative Staphylococcus aureus 24%, Acinetobacter spp. 18%, Pseudomonas aeruginosa 16%,

Diphtheroids spp. 12%, Enterococcus 8%, Stenotrophomonas spp. 6%, Staphylococcus aureus 4%, Morganella morganii 4%, Regression analysis revealed the incidence of contamination and risk of contact transmission was 2 to 4 fold high on active units such as the Covid Tent ER and Pedia Ward. Burkholderia spp. 2% and Streptococcus spp. 2% which were only found on Pedia Ward. Hospital acquired infection (HAI) on post op patients at surgery ward are low risk.

Zonrox Bleach Original was able to kill most of the identified isolated bacteria with a high disinfecting percentage of almost 100% to all species, followed by Green Cross 70% ethyl alcohol that has shown to kill a wide range of isolated organisms 72% (8/11) but not adequate enough to eradicate some of the isolated Bacillus spp. and Coagulase-negative Staphylococcus aureus. Lysol is effective against Pseudomonas aeruginosa, Acinetobacter species, Coagulase-negative Staphylococcus aureus and Diphtheroids species but not Bacillus spp, while Domex Ultra Bleach is effective against Coagulase-negative Staphylococci and Stenotrophomonas but not against Pseudomonas aeruginosa, Bacillus spp. and Acinetobacter spp

**Conclusion:** Fomites, such as medical chart cases can serve as a reservoir for opportunistic and pathogenic bacteria than can predispose healthcare workers to become a vector in causing hospital acquired infections (HAI) to patients through close contact. Cross transmission is possible acquiring bacterial contamination through our hands by touching medical chart cases during our shifts and hospital staffs during their tour of duty. Most of the time medical chart cases regardless of the ward or unit they belong should always be considered to be harboring opportunistic infection that can cause HAI, disinfection and sanitation of medical equipment and work surfaces is highly advised as frequent as possible and during every shifts. Zonrox Bleach is effective against wide array of gram (+), gram (-) bacteria and pathogenic species that can highly contribute to Hospital acquired infections. It has shown 100 percentages no growth on culture and high bactericidal activity with an 84% disinfection rate. Green Cross 70% Ethyl alcohol though is not the recommended alcohol content for disinfection (80% -90% as recommended on journals and CDC guidelines) still showed to have a high bactericidal activity with an 80% disinfection rate.

**Key words:** Medical Chart Cases; Bacterial Contamination; Fomite; Staphylococcus aureus; MRSA; Drug resistance, patient care items; fomite; healthcare associated infection; outbreaks; nosocomial infection; Disinfecting agents

## Introduction

Medical chart cases in general wards and special units are prone to contamination and can serve as reservoirs and vectors of opportunistic and nosocomial pathogens that can be transmitted from hands of healthcare workers (HCW) to patients via close contact and may contribute to Hospital acquired infections (HAI). Fomites are inanimate objects that can be a vehicle for transmission of infectious and opportunistic agents, they consist of porous and nonporous surface or objects that can be contaminated with pathogenic and opportunistic bacteria which can contribute to the upsurges in increase in number of Healthcare associated infections.

Healthcare associated infections is one of the leading cause of morbidity, mortality and unduly prolonged hospital stay adding burden among patients and sets an impending risks to healthcare workers, not only here in the Philippines but also in, well established countries. A recent surveillance study by the World Health Organization was conducted in 55 hospitals of 14 countries from Europe, Eastern Mediterranean, Southeast Asia and Western Pacific area reported HAI prevalence of 8.1%. Among hospitalized patients in the Philippines, a study by F. Michael, Barker et al found out that the Philippines has

high burden of HAI. Facilities and barriers to hospital infection control were evaluated at a private tertiary hospital in Manila [1].

During SARS infection pandemic, The Philippine Hospital Infection Control Society Inc. (PHICS) conducted a study and revealed 21% of total SARS infected were HAI and Healthcare workers. HAI are localized and systemic conditions resulting from adverse reaction to the presence of infectious agents or toxins. There must be no evidence that the infection is present or incubating at the time of admission to acute care setting. Infection acquired 48 hours after admission to hospital not present or incubates at the time of admission and infection acquired while in the hospital is developed during after discharge up to 6 weeks [2].

High prevalence of HAI occurs in among children, elderly patients with multiple co morbidities, pediatric, immune compromised patient and post op admitted patients who have undergone invasive procedures. One of the most frequently handled objects in the hospital is Medical charts of the patients. Contact to medical chart case surfaces by doctors, nurses, respiratory therapists, nursing aide is unavoidable due to doing entries of doctors, carrying out their orders, charting, round entries by nurses etc. on every shift and tour of duty. This predisposes the medical chart cases as reservoir for multiple contact and contamination

from HCW and environment. Although hand washing has been known to disrupt the vicious cycle and can effectively reduce the transmission of resistant pathogenic bacteria with an established disinfecting method, it is not frequently monitored nor practiced, disinfection and sanitation using an agent available in the market still lacks formal studies, research and clinical trials especially related to accuracy on effectiveness as a disinfecting agent. Recommended medical grade disinfecting agents are expensive and are not readily available for access by some healthcare institutions and facilities from the public sector and far flung areas with limited budget from the government [3-8].

Healthcare workers adherence to control measures, which is deemed important, is largely affected by the knowledge, attitude and practices during their shift. Microorganisms are generally transmitted to patients via the hands of healthcare professionals or through the patient's direct contact with contaminated material or environment.

Patient's safety emerges as structural component and key variable of the quality of health care. It is of paramount importance to study the hospital environment in the transmission of pathogens as it may clarify the issues involving the triad of microorganism, susceptibility and environment. This study was conducted to determine the rate of contamination of medical chart cases from the different wards and special unit and isolation of potential and pathogenic bacteria as source of infection at Mary Johnston Hospital for identification in order to provide a recommendable disinfecting agent that is cost effective and readily available.

The battle against hospital acquired infection is still ongoing in the Philippines, and at the present pandemic of COVID-19 it is an utmost importance of raising awareness for the importance of hand hygiene, close contact transmission, cross contamination, sanitation and hospital acquired infection. To the best of the researcher's knowledge there is no formal studies yet that has focused with identifying and assessing medical chart cases, though disinfecting agents have stand and have claims regarding their disinfecting capacity, up to date there is a lack of data and research studies to establish and cement their claims to the public and health care community.

### Review of related literature

The number of hospital-acquired infections (HAIs) has been growing exponentially worldwide, especially due to the emergence and wide spread of multidrug-resistant (MDR) bacteria. Multidrug resistance is an intrinsic and inevitable aspect of microbial survival and has been a major problem in the treatment of bacterial infections. The evolution of bacterial resistance is a consequence of the indiscriminate use of antibiotics and of the transmission of resistance within and between individuals. The lack of new clinically relevant classes of antibiotics constitutes a major threat to public health. HAIs are among the major causes of death and increased morbidity among hospitalized patients, with a minimum of 175,000 deaths every year in industrialized countries [9-12]. Several investigations showed that 60% of worldwide HAIs have been linked to the attachment of different pathogens to medical implants and devices, such as venous and urinary catheters, arthroprostheses, fracture-fixation devices

and heart valves. Additionally, it has been demonstrated that the increased incidence of HAIs is related to cross-infections from patient to patient or hospital staff to patient and to the presence of pathogenic microorganisms that are selected and maintained within the hospital environment (including equipment).

Poor infection control practices may facilitate patient-to-patient transmission of pathogens; for instance, in the accommodation of multiple patients in the same room. However, failure of the immune system due to illness and/or the use of immune suppressors and other therapeutic drugs can increase the patient's susceptibility to infections. Moreover, the use of antibiotics can inadvertently select antibiotic-resistant microorganisms. Since the environment serves as an important reservoir for infectious organisms, the control of hospital infections is a matter of great concern and a major challenge. The introduction of optimized disinfection products and processes is critical to control and prevent the spread of nosocomial infections, cross-resistance and persisted cells. Requirements regarding the antimicrobial activity of disinfectants in the medical field have been defined in various European standards. Also, guidelines have been developed by the CDC, which recommend hospitals to thoroughly clean and disinfect environmental and medical equipment surfaces on a regular basis. However, there is a variety of products available on the market with moderate or even insufficient antimicrobial action yet data on formal research and clinical trials challenging their claims is lacking and few.

The main hospital pathogens that contribute to increase in HAI cases is associated with the higher capacity of bacteria to resist and adapt to harsh environmental conditions, including the presence of antimicrobial agents. Deadly pathogens can survive for long periods of time on hospital surfaces, making the environment a continuous reservoir of infectious agents. The adhesion of pathogens to a surface

Some of the most important pathogens involved in HAIs include opportunistic Non-coagulase, Methicillin-resistant *Staphylococcus aureus* (MRSA), *Clostridium difficile*, *Pseudomonas aeruginosa*, vancomycin-resistant *Enterococcus* spp. (VRE), *Acinetobacter baumannii* and some *Enterobacteriaceae* strains. Most of these pathogens can survive for months on surfaces. Some investigations have proposed that Gram-negative bacteria persist longer than Gram-positive bacteria and, although it has been suggested that the type of surface does not influence the period of persistence, it has also been shown that longer persistence may occur on plastic surfaces or even on steel. In terms of environmental conditions, lower temperatures (4-68°C) and high humidity (70%) improved the persistence of several bacteria, fungi and viruses. There is clinical evidence suggesting an association between poor environmental hygiene and the transmission of microorganisms causing HAIs. The potential for contaminated environmental surfaces to contribute to pathogen transmission depends on two important factors: the pathogens must survive on dry surfaces and the contamination has to occur on surfaces commonly touched by healthcare workers and healthcare staff at a sufficiently high level to enable transmission to patients. Moreover, pathogen transmission will also depend on the infectious dose and route of transmission, along with host susceptibility. Shared clinical equipment that comes into contact

with intact skin, despite being unlikely to introduce infection, can also promote the transfer of microorganisms between patients. The most frequently contaminated surfaces are floors, doorknobs, television remote control devices, bed-frame lockers, mattresses, bedside tables and toilet seats in rooms previously occupied by an infected patient. Wilcox et al. found that 50% of commodes, toilet floors and bed frames sampled at a hospital were contaminated with *C. difficile*. Medical devices, including stethoscopes and otoscopes, are highly prone to be contaminated with bacteria and have been implicated as potential vectors of cross-transmission. Moreover, bacteria were found on various plastic items in the hospital, including pagers and cell phones Cotterill et al.

Provided suggestive evidence that contaminated ventilation grills were sources of MRSA outbreaks in hospitals. Additionally, an estimated 20%–40% of HAIs have been attributed to cross-infection via the hands of healthcare personnel, who have become contaminated from direct contact with the patient or indirectly by touching contaminated environmental surfaces [8]. In fact, hand hygiene is a major contributing factor to the current infection threats to hospital inpatients. Barker et al. showed that norovirus is consistently transferred via the fingers to melamine surfaces and from there to other typical hand-contact surfaces, such as taps, door handles and telephone receivers [9]. Pessoa-Silva et al. demonstrated that hands become increasingly contaminated with commensal flora and potential pathogens during neonatal care and those gloves do not fully protect the workers' hands from contamination [7]. Pittet et al. concluded that bacterial contamination increased linearly with time on ungloved hands during patient care. This demonstrates the importance of decontaminating hands before every patient contact [8]. Fendler et al. concluded that the use of an alcohol gel hand sanitizer decreased infection rates during a 34 month period and can provide an additional tool for an effective infection control program [4]. The same conclusion was reached by Hilburn et al. The gloves of medical staff are also easily infected from direct contact with an infected patient or, indirectly, by touching contaminated surfaces, which serve as a carrier for pathogenic microorganisms. In a study focused on MRSA infection, 42% of personnel gloves that contacted the furniture/surfaces of a patient room but had no direct contact with infected patients were contaminated. More significantly, it was found that 65% of the nursing staff that had directly treated an infected individual contaminated their gowns/uniforms with the organism [9]. The white coats, shirts and ties of doctors have also been found to contain potentially pathogenic flora. Disinfectant selection Maintenance of a good hospital environment requires the implementation of adequate strategies. Such strategies are described in guidelines proposed by several committees, particularly the Healthcare Infection Control Committee.

## Objectives

- To determine the rate of contamination of medical chart cases on the different wards and special units of Mary Johnston Hospital ( Medical, Surgery, Pediatrics, Ob-gyn and special ward unit MICU/ SICU, PICU, Covid ward and Covid Annex)

- To isolate and identify pathogenic bacteria that can contribute to hospital acquired infection through healthcare worker transmission via close contact to patients and prevention of potential sources of nosocomial infections.
- To identify and recommend a readily available, cost effective disinfecting agent that can be used effectively for disinfecting medical chart cases and recommend it to infection control committee of Mary Johnston Hospital and other health-care institutions and facilities as well [10-20].

## Methodology

### Study Design and Research Site

A descriptive, randomized sampling randomized controlled triple-blind design was used for this research study trial. The collection of specimen was swabbed from the sterile gloves that have close contact with selected randomized medical chart cases. The procedure was for the sterile gloves demonstrate transmission from the fomite to hand. Charts that was included in this study fulfilled the requirements of the inclusion and exclusion criteria. Application of disinfecting agent followed after collection of base line specimen. The researcher, the medical technologist under bacteriology section and statistician who analyzed the data was blinded from the randomization of specimen baseline, disinfecting agent applied to randomized chart cases, isolation of bacteria from the randomly assigned charts with treated specimen samples and the area of the hospital which specimen was collected.

An experienced Clinical research associate (CRA) was hired to prepare the disinfecting agent, randomize the medical chart cases and allocation to randomized assigned disinfecting agent. This was done in order to avoid bias and confounding factors and assure concealment of allocated randomized specimen and disinfecting agent. Breaking of the blind was done after the research study trial was finished, results from the central lab and from data from the statistician was secured. This research was conducted from July 5, 2020 to September 30, 2020, prior to commencement of this study, a research protocol was provided and was approved by the Research Ethics Committee of Mary Johnston Hospital. A week was allotted for the preparation of materials, for the collection of the specimen and 2 weeks for the bacterial culture isolation growth and species identification. This Research study was conducted at Mary Johnston Hospital.

### Sample Size, Sampling and Collection

A minimum sample size of 50 medical chart cases is the recommended size for this study with 5% margin of error 99% confidence interval ( $P > 0.05$ ; critical value  $z$  score of 2.5%) from the total number of medical chart cases with active admission and functional bed of 70 from 120 bed capacity during the pandemic period. The specimen samples collected came from the randomly assigned charts from general ward and special unit of Mary Johnston Hospital. This includes but not limited to Medical Ward, Surgery Ward, Pediatric Ward, Ob-gyne ward, MICU, SICU, PICU, Clean Emergency Room, Covid Emergency unit, Covid Medical Ward and Covid Medicine Annex.

### Inclusion Criteria

All medical charts cases of active hospital beds and with admissions for the last 14 days but not less than 5 days from the Medical Ward, Surgery Ward, Pediatric Ward, Ob-gyne ward, MICU, SICU, PICU, Clean Emergency Room, Covid Emergency unit, Covid Medical Ward and Covid Medicine Annex were included for randomization.

### Exclusion Criteria

Considering the differences in frequencies of handling the charts, medical charts of bed who had no admissions for the past 2 weeks, no admissions for the last 14 days and had remained on the storing rack were excluded in order to avoid randomized and selection bias. Furthermore, both of excessively short and long hospitalizations may be major confounders for sampling the medical charts. Since a longer hospital stay may increase the chance of contamination of medical charts, charts of patients who had been in hospital for more than two weeks were excluded. Except for patients in the surgical unit with a usually rapid turnover rate, Investigator excluded patients hospitalized for <3 days. Medical Chart cases in the nursery were excluded because they don't use medical chart cases. Physicians and nursing staff often complete all their records including admission, progress and discharge notes at one time and medical charts are handled with low frequency. Otherwise, medical charts that met the inclusion criteria in the general wards and special units were totally collected by means of an randomized sampling rather than being selected according to the investigator's preference (highly selected samples) to avoid selection bias. In order to avoid inter- investigator bias and inadequate sampling of the medical charts (measuring bias), The CRA will be the one to assign and randomized medical chart cases and the investigator was blinded on collecting the baseline and treated specimen. Finally, considering the possible effect of time or seasons on organisms, charts in general wards and their corresponding special units (i.e., medical wards vs. MICU; surgical wards vs. SICU; pediatric

wards vs. PICU; Ob-Gyn wards vs. special units) were sampled in the same day of data collection to avoid confounding bias. MICU/ SICU was automatically excluded due to none functionality and under renovation during the period of specimen collection of this study.

MICU/SICU was automatically excluded due to none functionality and under renovation during the period of specimen collection of this study.

### Study Population of Chart Cases from Ward and Special Units of the Hospital

In our hospital, medical charts are handled mainly by the physicians and nursing staff. Due to different characteristics in different units, it is not clear how many times per day the charts are handled in each unit. We only know that the nurses in all wards and those in ICUs have the same frequency of shifts (12 hours per shift; two shifts per day). Also, the physicians in general wards and those in ICUs have the same frequency of shifts (30 hour per duty). All physicians and nurses handle the medical charts multiple times per shift. It's a daily routine on every duty to do entry notes, carry out orders, updates, recording of vital signs, input and output, etc. Medical charts in general wards and in ICUs are kept on the chart rack at the nursing station, where the charting is done. All the medical charts throughout the hospital are identical and ideally be replaced every 5 years. Basically, medical charts are not specially taken down unless there are extra instructions or changes of hospital policy.

Tables 1 to 6 shows the total hospital bed capacity of the hospital. Out of 120 beds only 70 beds were functional and with active admissions during the period when the study was conducted, the table shows the different wards and special unit of Mary Johnston Hospital. Colored cells from the table are the chart cases of hospital room bed counterpart which adequately passed the inclusion and exclusion criteria. These chart cases underwent randomized sampling using an automated Randomizing app down- loaded at Google by the Clinical research associate.

**Table 1:** Medical Chart Cases from Medicine Ward.

227-1	238-4	240-1	275	284	MICU-4
227-2	238-5	240-2	276	285	MICU-4
229-1	238-6	240-3	277	286	MICU-5
229-1	235-1	240-4	278	287	MICU-6
231	235-2	240-5	279	288	ISO EXT 1
233	235-3	240-6	280	289	ISO EXT 2
238-1	235-4	270	281	MICU-1	ISO EXT 3
238-2	235-5	271	282	MICU-2	ISO EXT 4
238-3	235-6	273	283	MICU-3	

**Table 2:** Medical Chart Cases Surgery Ward.

323-1	330	334	340
323-2	331	335	SICU-1
323-3	332	336	SICU-2
324- 1	333-1	337	
324-2	333-2	338	
325	333-3	339	

**Table 3:** Medical Chart Case of Pedia Ward.

201	218 b	206-2	206-6
203	204 -1	206-3	212
205	204-2	206-4	208-1
218 a	206-1	206-5	208-2
208-3	208-5	214-1	214-2
208-4	208-6	214-3	214-4
208-1	208-3	214-5	214-6
208-2	208-4	208-5	208-6
PICU-1	PICU-2	PICU-3	ISO-2
218-A			

**Table 4:** Medical Chart Cases of OB Ward.

301	306-4	318-1	320-1
303	306-5	318-2	320-2
304	308	319-1	320-3
305	310	319-2	320-4
306 -1	312	319-4	ISO
306-2	317-1	319-5	
306-3	317-2	319-6	

**Table 5:** Medical Chart Cases Covid ER.

TENT 1	TENT 2	TENT 3	TENT 4
TENT 5	TENT 5		

**Table 6:** Medical Chart Cases Clean ER.

Bed 1	Bed 2	Bed 3	Bed 4
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Chart cases were also randomly assigned less than one of the disinfecting agents for treatment. They were randomly allocated and distributed amongst Green Cross 70% ethyl alcohol, Zonrox Bleach Original, Lysol and Domex Ultra Bleach (Table 1-6).

The researcher, medical technologist and statistician were all blinded. Allocation was concealed and randomization of coded specimens relayed via electronic mail and phone call.

### Randomization, Sampling and Coding of Medical Charts

All medical chart cases which had admissions in the last 2 weeks and whose assigned room was actively being decked with patients were pooled. A randomizing app downloaded from Google app and using android phone was used for randomization to avoid bias and confounding factors of chart cases selection and assignment. Medical chart cases that have passed the inclusion and exclusion shall be submitted by the researcher to the research associate via email. The clinical research associate will

randomized them using the app and assign to their designated coded serial number. The clinical research associate shall also randomize which disinfecting agent shall be applied and used on the assigned medical chart cases. Once randomly assigned and selected with the randomized disinfecting agent, the researcher was informed via phone and email of the provided list of randomized assigned chart cases for collecting baseline specimens and assigned disinfecting agent on specimen for collection.

### Procurement of Materials, Collection and Logistics in handling the specimen

Materials for specimen collection and the disinfectants used in this research study were purchased from Mercury Drug in Moriones Tondo and Bambang Avenue, Manila. The following are the materials:

1. 100 pcs Sterile Swab
2. 100 pairs of Sterile Gloves
3. 100 Amies Transport Medium
4. Sterile Saline 1 L
5. 250 ml Zonrox
6. 250 ml Domex
7. 200 ml Disinfecting Spray
8. 250 ml 70% Ethyl Alcohol
9. 100 Sterile Gauze
10. 4 Amber bottles for Randomized prepared disinfecting agent

### Collection and Concealed Allocation of Specimens

Randomized Medical Chart Cases were prepared for specimen collection. Researcher wore Level 3 PPE, Sterile gloves was worn

and changed during every specimen collection to ensure sterility and avoid contamination. Baseline specimens were collected from the sterile glove hand that had touched the outer surface of the medical chart cases. Sterile swab with Sterile Saline was swabbed and rolled on the sterile gloves used to touch the chart case surface front and back for 1 minute. Gram Stain specimen is collected by smearing on an autoclaved sterile glass slide and then stabbing to Amie's Transport Medium for growth and transport to central lab for culture. Before sealing, the opening of amies transport medium was swiped on lighter flame to prevent contamination and maintain sterility of the specimen. The smeared specimen was fixated with heat flame in preparation for Gram staining. After collecting the baseline specimen, the blinded researcher shall apply the prepared randomized disinfecting agent to the randomized medical chart cases by the clinical research associate. Disinfecting agent was applied on square cycle manner for full coverage both front and back. The disinfected chart cases are allowed to dry after application, post treated sample specimens were collected after 1 minute. A sterile swab with sterile saline was swabbed and rolled on the front and outer disinfected surface of medical chart cases.

A Gram stain specimen was also obtained from post treated specimen which were subjected for staining. The specimens collected from amie's transport medium are then inoculated on a the following prepared agar for initial growth and isolation of a colony. This includes:

1. Blood Agar Plate (BAP)
2. Chocolate Agar Plate (CAP)
3. Eosin-Methylin Blue (EMB)
4. Mannitol- Salt Agar (MSA)
5. Bile Esculin Agar (BEA)
6. Mac Conkey agar

The inoculated plates were placed on a calibrated incubator for incubation and observation at an optimal temperature to hasten the growth colony. Upon successful growth and isolation of the colony, they are transferred and prepared for biochemical testing panel via stabbing and inoculation with the use of sterilized inoculating loop and sterilized stabbing of stab wire. The following are included in biochemical testing for genus and species isolation and identification:

1. Sulfur Indole Motility Media
2. Kligler's Iron Agar
3. Nitrate Broth
4. Simmon Citrate Agar
5. Methyl Red/ Voges -Proskauer (MR/VP)
6. Lysin Iron Agae (LIA)
7. Motility Agar

Measurement of colonies and antibiotic susceptibility testing was done from Mueller Hinton Agar. Procedures used for culture was based on standard operating procedures and microbiological specimen processing based from the approved central lab

protocol. The research investigator collected the baseline sample and treated sample at 6:30 am to 9:30 am. Specimen was stabbed on Amie's transport medium provided by the Binangonan Lake View Hospital Central Lab which conducted the environmental analysis and bacterial culture. Specimens were properly labelled with the allocated randomized assigned code and sealed individually on a transparent sterile zip lock with label of collected date, time of collection, collector of the specimen and site of collection, in accordance to the Center of Disease Control (CDC) guidelines of environmental specimen collection. Labeling is very important and vital it is important to avoid mislabeling and mishandling of the specimen. The researcher brought the specimen to the Lab unit which will process the specimen for the growth and identification of the bacteria the same day. The researcher delivered the specimens via Grab.

### Preparation of Disinfecting Agent

The Clinical Research Associate (CRA) prepared the disinfecting agent in accordance to the product instruction usage. The following disinfecting agents were purchased from a Local Drug store with in the vicinity of Mary Johnston Hospital. The CRA prepared the solutions on a sterile amber glass container, this is to blind the investigator and prevent the researcher from being bias and avoid confounding factors that may affect the result of this study. The solutions used were Lysol, Zonrox and Domex. A prepared aliquot solution was based from the recommended and printed instruction on the product packaging, 60 ml of 70% Ethyl alcohol was directly prepared from the bottle. The following were the randomized disinfecting agents used in this study with their corresponding active ingredients and their preparation:

#### Green Cross 70% Ethyl Alcohol

Active Ingredient: Ethyl Alcohol

**Lysol Disinfectant Multi Action Cleaner aliquot preparation: 60ml in 1 L water**

Active Ingredient: Benzalkonium chloride

**Zonrox Bleach Original aliquot preparation: 3 tbsp in 1L of water**

Active Ingredient: Sodium Hypochlorite

**Domex Ultra Bleach thick Bleach preparation: 30 ml in 2.5 L of Water**

Active Ingredient: Sodium Hypochlorite

### Laboratory Surveillance

The following laboratories was randomized by the CRA using an automated randomizing application, These are the labs known to be providing and conducting environmental bacteriologic identification and isolation for research studies.

San Lazaro Hospital NRL

Up Institute of Biology Microbiology division

Binangonan Lake View Hospital Environmental Lab Division

Upon randomization Binangonan Lake View Hospital Environmental Lab was selected by the randomizing app.

## Specimen Handling

Baseline specimens collected from the surfaces of medical chart cases pre and post treated with randomized disinfecting agent were transported to the randomized chosen central lab of Binangonan Lake View Hospital, swabs were collected and placed on amie’s transport medium properly labeled and was placed an individualized biohazard zip lock bag with identification and randomized code. This is to ensure safety, preserve it’s sterility and prevent specimen mishandling. The researcher placed specimen on a specimen container carrier, proper specimen collection and was strictly observed. Specimens were obtained in the proper tubes, smeared glass slide specimens, correctly labeled, and was then promptly transported to the laboratory.

## Outcome Measures

The outcome measures will included the overall incidence of eradication of bacterial contamination found in hospital medical charts cases in all general wards and special units, the reduction of risks among the differences in incidence of bacterial contamination found on medical charts between medical, surgical, pediatric, Ob-gyn general wards and their corresponding special units and the prevention of Hospital acquired infection from the prevalence of pathogenic bacteria species on the contaminated medical chart cases through the hands of health care workers and cross contamination through close contact with the patients and fomites.

## Data analysis

Data were collected and was analyzed using the SPSS statistical software package (Version 16.0, SPSS Inc., and Chicago, IL, USA). The statistics used in this study included descriptive statistics, the chi-square (X<sup>2</sup>) test, the Fisher’s exact test (for expected numbers <5) and the t test to compare differences in the characteristics and the results of the medical charts retrieved for sampling. Further analysis will be performed using logistic regression to estimate the odds ratios (OR) and 95% confidence intervals (CI) of the incidence of chart contamination in special units when compared to general wards (the reference group). Chart representations of results were created using 2016 Microsoft excel MS office.

## Results

Table 7 summarizes the isolated bacteria and the results of medical chart cases retrieved for randomized sampling in the study. We evaluated a total of 50 medical chart cases out of the 70 medical chart cases of currently active hospital beds from 120 bed capacities of Mary Johnston Hospital. After excluding the medical chart cases of hospital beds that did not meet the inclusion criteria included 50 randomized chart cases which were comprised of 27% (10/ 37) Pedia, 33% (8/24) OB-gyne, 31% (7/22) Medicine, 21% (5/21) Surgery, 100% (4/4) Covid-19 Clean ER, 100% (6/ 6 ) Covid 19-tent ER, 71% (10/14) Covid-19 Ward. The contamination rate of medical chart cases selected for sampling was 71.4% (50/70) in all wards and special unit. 100% growth and isolation of bacteria from Clean ER, Covid ER, Covid Unit, Surgery Ward, Med Ward, Ob-gyne Ward, Pedia Ward, and Pediatric ICU (Table 7).

Figure 1 shows 100% Isolation of bacteria from the randomized sampling population of charts. 11 bacterial isolates were isolated from culture positive charts, 45% were gram negative and 55% were gram positive. These isolates were cultured and undergone biochemical testing for species identification. Most identified isolates came from the Pedia Er and with the least from Surgical Ward. While the most populated pathogenic bacteria colony and high percentage risk of infectivity were from the Covid ER.

The most common bacteria isolated was *Bacillus* spp. 78% followed by Coagulase- negative *Staphylococcus aureus* 24% , *Acinetobacter* spp. 18% , *Pseudomonas aeruginosa* 16% , *Diphtheroids* spp. 12% , *Enterococcus* 8% , *Stenotrophomonas* spp. 6%, *Staphylococcus aureus* 4% , *Morganella morganii* 4% , *Burkholderia* spp. 2% and *Streptococcus* spp. 2% which were only found on Pedia Ward (Figures 1 and 2).

Randomized sampled medical chart cases were randomly assigned and distributed among 4 disinfecting agents by the Clinical research associate ( CRA). Zonrox Bleach Original was able to kill most of the identified isolated bacteria with a high disinfecting percentage of almost 100% to all species, followed by Green Cross 70% ethyl alcohol that has shown to kill a wide range of isolated organisms 72% (8/11) but not adequate enough to eradicate some of the isolated *Bacillus* spp. and Coagulase-negative *Staphylococcus aureus*. Lysol is effective against

**Table 7:** Isolated and Identified bacteria on ward and special unit of the hospital.

Identified and Isolated Bac- teria Killed by Post Treatment with Different Disinfectant Agents in Different Wards of Mary John- son Hospital	CLEA ER	NCOVI ER	DCOVI UNIT	DSurger WARD	yMED WAR	OB DWAR	PEDI DWAR	APICU DPE- DIA	TOTAL
<b>Acinetobacter Species</b>	1	1	1	0	1	1	4	0	9
<b>Bacillus Species</b>	3	6	2	4	5	8	6	0	34
<b>Burkholderia Species</b>	0	0	0	0	0	0	1	0	1
<b>Coagulase Negative Staphylococ- cus aureus</b>	0	1	1	2	1	4	3	0	12
<b>Diphtheroids Species</b>	1	3	1	0	0	0	1	0	6
<b>Enterococcus Species</b>	0	2	1	0	0	0	1	0	4
<b>Morganella morganii</b>	0	0	0	0	0	2	0	0	2
<b>Pseudomonas aeruginosa</b>	0	4	0	0	0	0	3	1	8
<b>Staphylococcus aureus Species</b>	0	0	0	0	0	1	1	0	2
<b>Stenotrophomonas Species</b>	0	1	0	0	0	1	0	1	3
<b>Streptococcus Species</b>	0	0	0	0	0	0	1	0	1
<b>NUMBER OF MED-ICAL CHARTS</b>	4	6	10	5	7	8	9	1	50

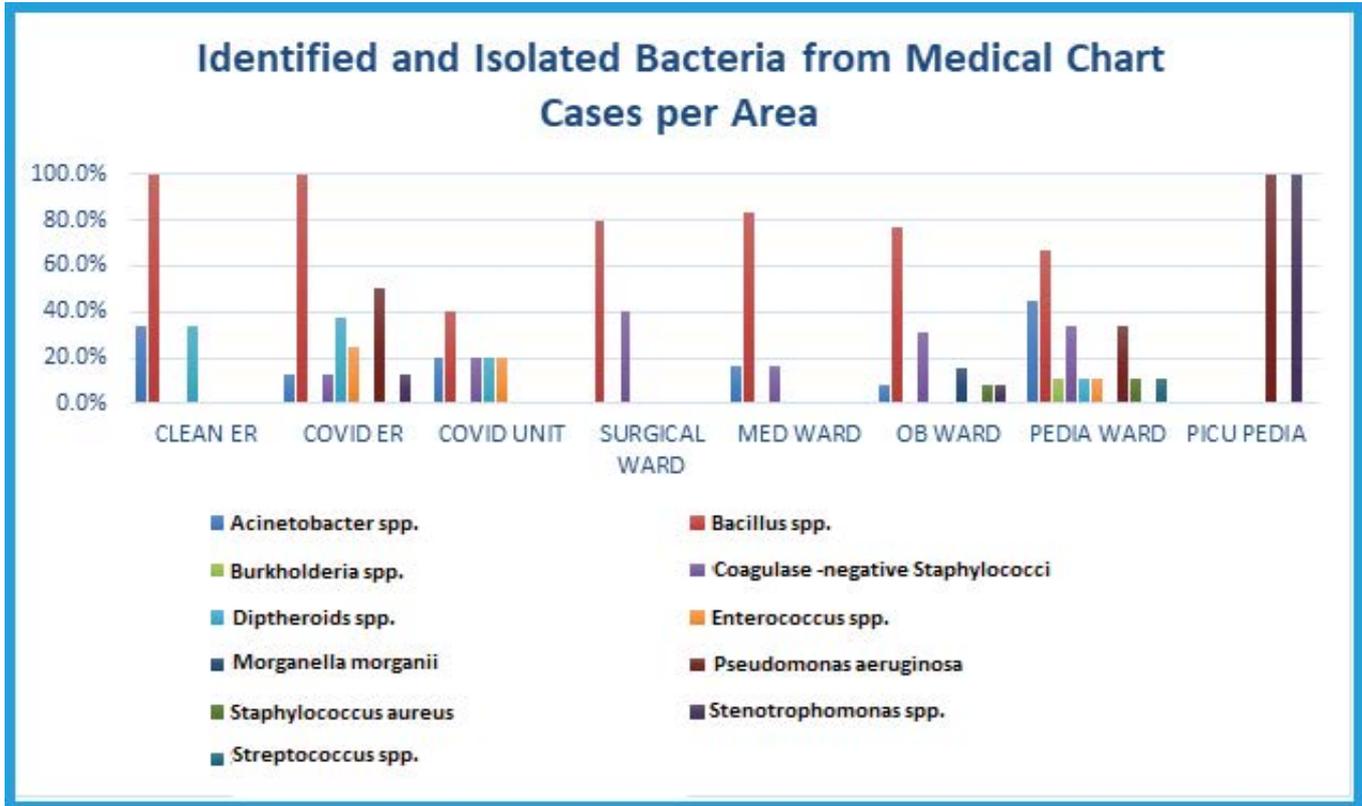


Figure 1 Identified and Isolation Bacteria from Medical Chart Cases per Area.

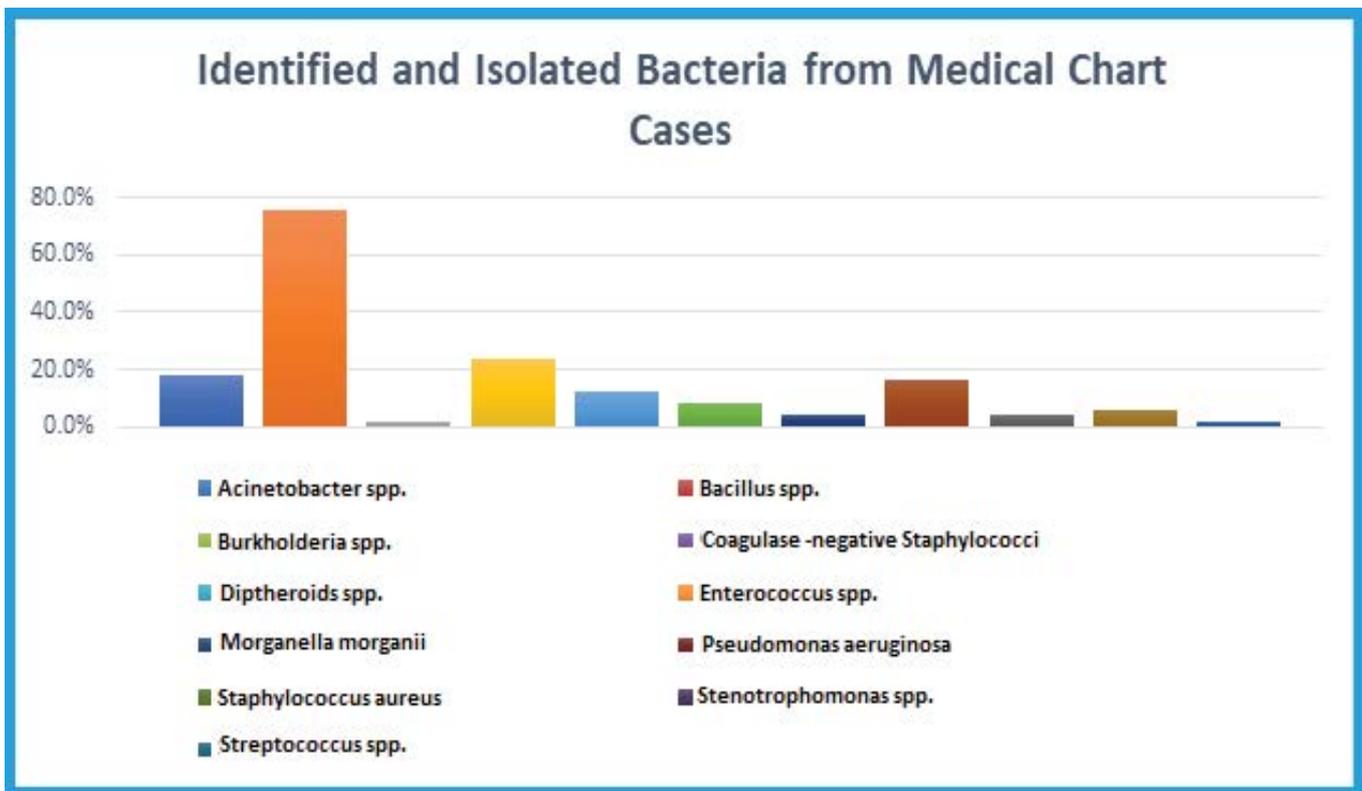
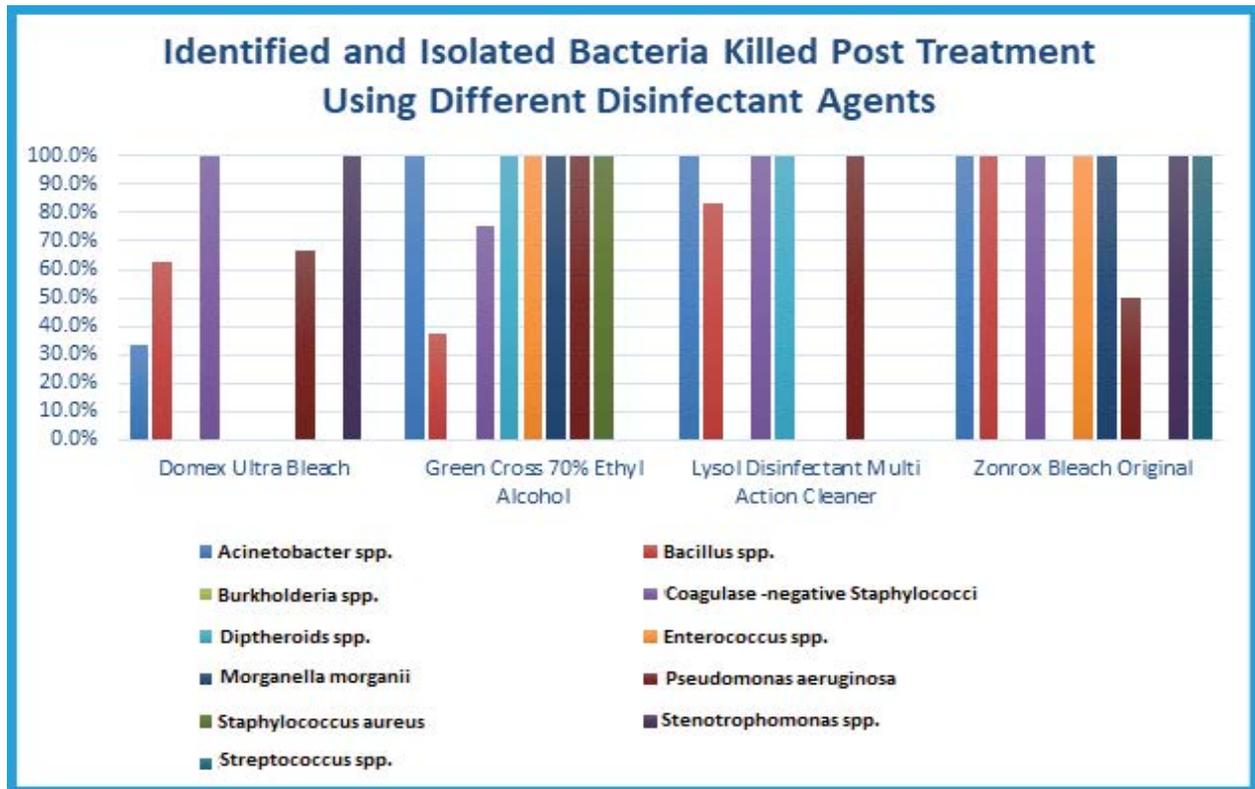
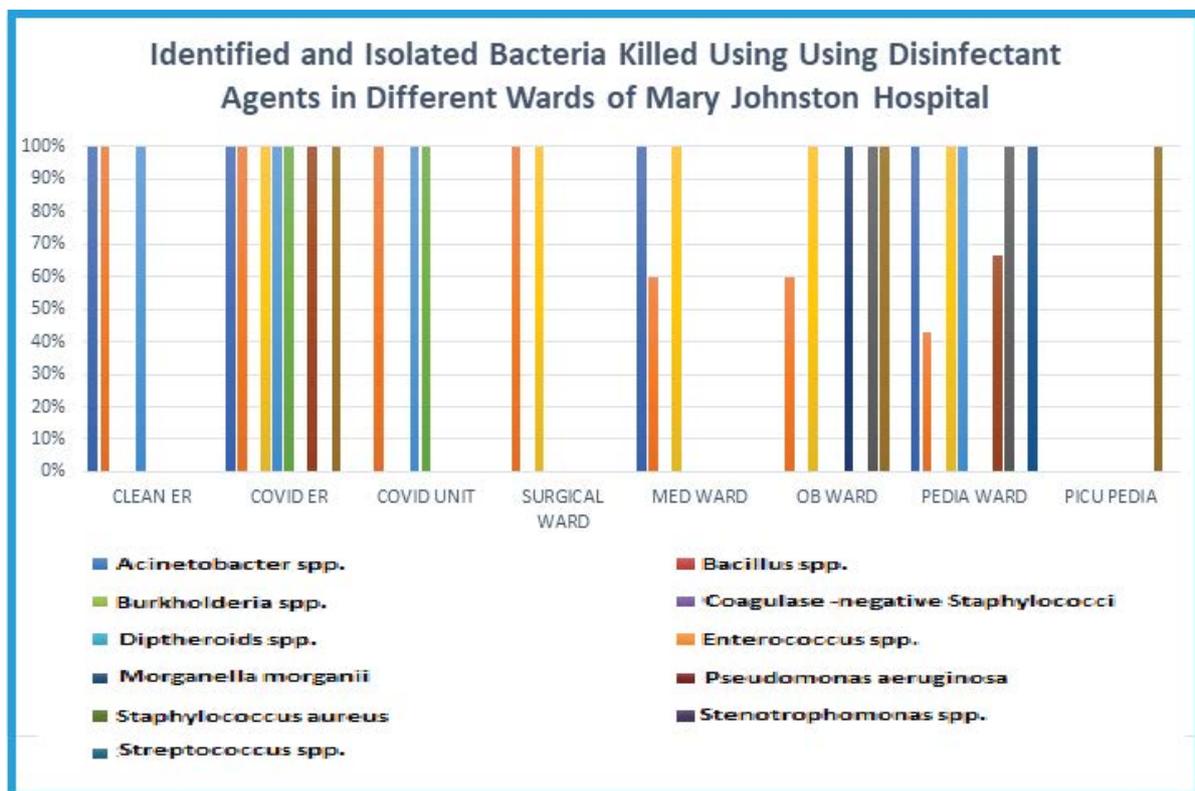


Figure 2 Identified and Isolated Bacteria from Medical Chart Cases.



**Figure 3** Identified and Isolated Bacteria Killed Post Treatment using different disinfecting agents.



**Figure 4** A comparison of incidence of bacterial contamination on sampled medical chart cases on wards and special ward units of Mary Johnston Hospital.

*Pseudomonas aeruginosa*, Acinetobacter species, Coagulase-negative Staphylococcus aureus and Diptheroids species but not Bacillus spp. Domex Ultra Bleach is effective against Coagulase-negative Staphylococci and Stenotrophomonas but not against *Pseudomonas aeruginosa*, Bacillus spp. and Acinetobacter spp (figure 3).

Post treatment of area using disinfecting agent has shown no growth of isolates at Clean ER, Covid ER, Covid Unit, Surgical Ward, Picu Pedia. Although Acinetobacter spp. and Enterococcus spp. was eradicated almost 60% of Bacillus spp. survived at Medicine ward and OB ward while 42% of Bacillus spp. and 67% of *Pseudomonas* survived in Pedia Medical Chart cases (figure 4).

It shows survival of Acinetobacter and Coagulase-Negative Staphylococcus aureus in medical chart cases that were randomized in to Green Cross 70% ethyl alcohol and Domex Ultra Bleach. Zonrox Original and Lysol were able to kill Acinetobacter spp. and Coagulase-negative Staphylococci aureus.

Chart cases from the Medicine Ward randomized to Zonrox Original showed 100% no growth while about 40% of bacillus species survived from Green Cross 70% ethyl alcohol, Lysol and Domex Ultra Bleach.

Acinetobacter spp. and 40% of Bacillus spp isolated from chart cases of OB ward which were randomly assigned to Green Cross 70% ethyl alcohol. Was able to survive. While 60% of all identified isolates were killed using Zonrox Bleach Original, Lysol and Domex Ultra Bleach was Identified and Isolated Bacteria killed by disinfecting agents in Pedia Ward Most identified isolated organisms was found in Pedia ward, Chart cases were randomized and assigned for post treatment with disinfecting agents. 100% of Acinetobacter Species, Coagulase Negative Staphylococcus Aureus, Diptheroids Species, Staphylococcus Aureus Species and Streptococcus Species were killed after using disinfectants. 100% of Enterococcus Species at Burkholderia Species survived. 40% of Bacillus spp. and 65% of *Pseudomonas aeruginosa* was killed. Lysol is not effective in killing Burkholderia Spp. and Green Cross 70% Ethyl alcohol was not able to kill isolated enterococcus spp. Lysol and Green Cross 70% Ethyl Alcohol was not able to eradicate *Pseudomonas aeruginosa* , 35% survival rate to both while All identified isolates randomly assigned to Zonrox original bleach and Domex Ultra had no growth.

Chart from Pedia ward ICU was randomized only with Zonrox original bleach. *Pseudomonas aeruginosa* was able to survive post treatment while Stenotrophomonas spp. was killed.

Domex Ultra Bleach is effective against Coagulase-negative Staphylococcus aureus, and Stenotrophomonas spp. 38% Bacillus spp, 36% *Pseudomonas aeruginosa* and 100% Enterococcus spp. may survived against Domex Ultra Bleach. It has an overall disinfecting percentage of 40% (3/5).

Most identified isolates that were randomly assigned to Green Cross 70% ethyl alcohol were killed. 24% of Coagulase-negative staphylococcus aureus survived. It has an overall disinfecting percentage of 80% (1/5).

Identified and Isolated Bacteria killed by Lysol Multi-action Cleaner

There was 100% of Burkholderia spp. and 18% of Bacillus spp. growth from randomly assigned medical chart cases used with

Lysol , the rest of the isolates were killed. It has a disinfecting percentage capacity of 60% (2/5).

Though 55% of *Pseudomonas aeruginosa* from randomized sampled charts were killed and 45% survived, most identified isolated bacteria from chart cases that were randomly assigned to Zonrox Bleach Original had no growth after post treatment (figure It has a disinfecting percentage of 84% (1/5)).

## Discussion

The microbial growth in the surfaces of medical chart cases studied shows the relevance of pathogens in hospital setting. The predominance of Bacillus spp. 78% followed by Coagulase-negative Staphylococcus aureus 24% , Acinetobacter spp. 18% , *Pseudomonas aeruginosa* 16% , Diptheroids spp. 12% , Enterococcus 8% , Stenotrophomonas spp. 6% , Staphylococcus aureus 4% , *Morganella morganii* 4% , Burkholderia spp. 2% and Streptococcus spp. 2% which were only found on Pedia Ward . Makes Healthcare professionals and hospital staffs be predisposed to contamination and cause transmission to patients through close contact during their bed side rounds with the patients.

Infections caused by gram-negative bacteria have features that are of particular concern. These organisms are highly efficient at up-regulating or acquiring genes that code for mechanisms of antibiotic drug resistance, especially in the presence of antibiotic selection pressure. Furthermore, they have available to them a plethora of resistance mechanisms, often using multiple mechanisms against the same antibiotic or using a single mechanism to affect multiple antibiotics.

The results of this study revealed 100% isolation of bacteria from the randomized sampled population of charts. 11 bacterial isolates were isolated from culture positive charts, 45% were gram negative and 55% were gram positive. Most identified isolates came from the Pedia Er and with the least from Surgical Ward. While the most populated pathogenic bacteria colony and high percentage risk of infectivity were from the Covid ER which increases the risk of Hospital acquired infection (HAI) specially to Immune compromised patients, pediatrics, elderly and post op admissions.

The medical chart cases are indeed a possible vector of bacteria and also a potential source of infection. This is particularly true of medical charts in the Pedia ward. The anterior and posterior surfaces of medical charts can harbor potential pathogens. In addition to CoNS, other causative and opportunistic pathogens were found on the surfaces of medical charts and the risk of chart contamination to cross transmission is possible through hand contact. Increased chart contamination by *Pseudomonas aeruginosa*, one of the most important and serious nosocomial pathogens. Chart contamination by other pathogens is also more common, and probably increases the risk of nosocomial infection.

A number of organisms, such as CoNS, *Corynebacterium* spp., and Bacillus spp., are common skin floras, and are considered relatively avirulent although they can be pathogenic in certain populations such as immune compromised persons with prosthetic devices, intravascular catheters, or other implanted devices. In fact, CoNS has become one of the most common

nosocomial pathogens in the hospital setting, and most species are multidrug-resistant. We reanalyzed our data after excluding chart contamination by CoNS, *Corynebacterium* spp., and *Bacillus* spp., and focused on chart contamination by other organisms that are regarded as pathogenic.

In order to explain the possible mechanisms underlying our data, we suggest that our results are related to the sources and the frequencies of "contact" within the wards or special units of the hospital. Medical charts are handled by physicians, nurses, and other medical staff while recording, looking-up and handing over to the next shifts. The charts are placed in nursing stations, in medical record rooms, or on the beds to be sent to examination rooms, operation rooms, or therapeutic rooms, and therefore are prone to bacterial contamination. In the ICUs, the use and manipulation of endotracheal and gastrointestinal tubes, which are possible sources of contaminants, may result in excessive bacteria transfer, contributing to a higher incidence of contamination of medical charts. This is not the case in Obs-Gyn special units, including delivery and tocolytic units, where endotracheal and gastrointestinal tubes are used less frequently.

The study herein has a number of strengths, including its relatively large sample size and a high sampling rate of hospital charts. Overall, a total of 50 charts were sampled and the total sampling rate exceeded 60% (71 % 50/70). Our results are therefore robust due to minimization of possible errors that originate from the sampling process. To the best of our knowledge, this is the first study of its kind to investigate the contamination of the hospital chart cases. Additionally, all bias resulting from the samples, from the investigator, from the sampling and measuring process were minimized as much as possible by the methods used. Samples were comparable in terms of their length of hospital stay because of these exclusions of patients with very short or longer stays. Therefore, any differences in colonization rates were not related to the duration of hospitalization. The fact that there were notable differences in average hospital stay but unremarkable differences in chart contamination between general wards and special units may be explained by the a rapid turnover of patients during their hospitalization and less infectious sources.

## Conclusion

There is great concern about the growth and prevalence of HAI due to the increased incidence of resistant bacteria. Furthermore, Conventional cleaning methods for the eradication of hospital environmental contamination seem to be inefficient. This manuscript reviews the disinfecting and bactericidal capacity of several disinfecting agents that can be used to overcome these problems. Most of the data currently available have been generated by the manufacturers and needed to be validated by independent investigations. Moreover, studies concerning microbiology and physiology allied to genomics and computer analysis should be applied to identify and understand the contributory and risk factors for Hospital acquired infections. Thus, further evaluation and implementation of measures and recommendable disinfecting agents for their validation in terms of sanitation and disinfection.

This study has demonstrated that Medical chart cases of Mary Johnston Hospital of wards and special units are harboring

potential pathogenic bacteria both gram negative and gram positive that can cause and contribute to HAI. Contamination and transmission from chart cases to hands of health care workers is possible as growth of colonies was cultured from the baseline swabs taken from sterile gloves. Chart cases from Pedia ward showed wide range of identified isolated bacteria and is the most contaminated, followed by medical chart cases from the ER Covid Tent Area. Post op patients from surgery ward are the least likely to acquire nosocomial infection, showing adherence of surgery ward staff nurses adherence and practice of disinfection and sanitation results revealed it has the least number of identified isolated species and has high rate of response to disinfection.

Among the 4 disinfecting agent, Zonrox Bleach Original with active ingredient of Sodium Hypochlorite showed to have the highest disinfecting percentage of 84% with most no growth of colonies from post treated, randomized collected specimen. Green Cross 70% Ethyl Alcohol has shown to be promising in terms of disinfection and sanitation with 80% disinfecting percentage capacity and a wide coverage of killing identified isolates from medical chart cases. Zonrox Bleach and Green Cross 70% Ethyl alcohol based on this research study has shown the effectiveness in removing clinical strains of *Bacillus* spp, Coagulase- negative *Staphylococcus aureus*, *Acinetobacter* spp., *Pseudomonas aeruginosa*, *Diphtheroids* spp., *Enterococcus*, *Stenotrophomonas* spp., *Staphylococcus aureus*, *Morganella morganii*, *Burkholderia* spp. and *Streptococcus* spp. in medical chart cases. The authors may recommend this to other hospitals, healthcare facilities and other institution to be used for sanitation and disinfection not only on medical chart cases but as well as on their working station. Lysol does not kill 99.9 and Domex Bleach does not leave all known germs dead as their product claims and advertisement on the market. A more in detailed and scientific research is recommended for verification of claims. Though both may be used in households it is not recommended to be used in hospital setting.

## Recommendation

The authors highly recommend to continue the practice of hand washing with adequate lathering of soap to prevent contact contamination. Though hand washing remains to be the best modality to prevent acquired contamination from hospital equipment surfaces, the practice and application is not frequently monitored if it is being done. Disinfection and sanitation of hospital work places are also not habitually practiced. The researcher recommends Zonrox bleach as the best agent to be used in Mary Johnston Hospital for disinfection and sanitation purposes to manage infection control and prevent the potential risk of hospital acquired infection. Green Cross 70% ethyl alcohol is also recommended to be used post contact with medical chart surface. Alcohols are very effective at quickly destroying a variety of pathogens and that too without the need for water, plumbing, and drying facilities. According to the World Health Organization (WHO), alcohols have an excellent activity against gram-positive bacteria, gram-negative bacteria, enveloped viruses, non-enveloped viruses, mycobacteria, and even fungi. This study has demonstrated the in-vivo antimicrobial activity of Zonrox Bleach and Green Cross 70% Ethyl alcohol in the effectiveness in removing clinical strains of *Bacillus* spp, Coagulase- negative

Staphylococcus aureus, Acinetobacter spp., Pseudomonas aeruginosa, Diptheroids spp, Enterococcus, Stenotrophomonas spp, Staphylococcus aureus, Morganella morganii, Burkholderia spp. and Streptococcus spp. in medical chart cases. The authors may recommend this to other hospitals, healthcare facilities and other institution to be used for sanitation and disinfection not only on medical chart cases but as well as on their working station. Lysol does not kill 99.9 and Domex Bleach does not leave all known germs dead as their product claims and advertisement on the market. A more in detailed and scientific research is recommended for verification of claims. Though both may be used in households it is not recommended to be used in hospital setting.

Maintaining hand hygiene, disinfection practices and sanitized work place in hospitals, healthcare facilities and other health institutions has been established as crucial standards for reducing the growth, colonization and incidence of infectious diseases that can predispose risk to healthcare workers and patients in all populations. Compliance with strict adherence is reminded and advised. In a future study, we plan to investigate the effects of regular cleaning by an intervention of wiping down the surface of the chart. It will also be interesting to see if modification of traditional plastic chart cases with anti-bacteria materials, like nanomaterials, can prevent the adherence of bacteria to the outer surface of the medical chart. Alternatively, the use of electronic medical records instead of hard medical charts may theoretically decrease the opportunity of contact. By doing so, clinical staff could avoid direct contact with hard medical records as the vectors of pathogens. Additionally, clinical staff could view the medical information of the patients on-line without the use of medical charts, although some contact with the interface (keyboards or screens) is still inevitable. A detailed discussion of these future attempts is beyond the scope of our study, but we believe that further efforts could be made to explore the relationships between contaminated medical charts and HAI, as well as all feasible attempts in the future.

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