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A Nurse-Led Low-Cost Intervention Effectively Traces Prevalence of Catheter Associated Urinary Tract Infections at a Low-Resourced Regional Referral Hospital in Western Uganda: A Case for Policy Change

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Abstract

Catheter associated urinary tract infection (CAUTI) is the most common hospital-acquired infection worldwide. Low- and middle-income countries (LMICs) with limited resources for health care have not allocated resources to adequately monitor or prevent CAUTIs. The infection is associated with several adverse clinical outcomes, including antibiotic resistance, septicemia, and prolonged hospital stays, that burden the already resource-constrained health systems in LMICs with increased morbidity, health care costs, and deaths. Owing to the lack of resource allocation, little is known about the prevalence of CAUTI in the government-owned and operated hospitals in LIMCs. The purpose of this research was to test a method of CAUTI prevalence surveillance suitable to the resource-constrained health system in a LMIC and to determine the prevalence of CAUTI among hospitalized patients at the study site. In an intermittent 4-week data collection plan, the sample of 68 catheterized adult participants was evaluated for the presence of CAUTI using the three-pronged screening criteria of American Urological Society. CAUTI prevalence in the sample was 17.6%. The high prevalence of CAUTI in this sample represents a substantial risk of consequences to hospitalized patients and to the resource-constrained health system in this LMIC. This first report of CAUTI surveillance using readily available and affordable tools provides evidence to health ministry policymakers of the need for and value of monitoring and prevention programs for hospital-acquired infections in LMICs. We recommend LMIC health policymakers to establish infection prevention teams in hospitals and provide resources to continue surveillance and prevention of CAUTI and other hospital-acquired infections.

Keywords

hospital-acquired infection, catheter-related infections, resource allocation, prevalence, prevalence study, outcome assessments (health care), sub-Saharan Africa, less developed countries

Globally, catheter association urinary tract infections (CAUTIs) are the most common hospital-acquired infections (HAIs). They can result from the inappropriate use of urinary catheters or from the faulty handling of the catheter while it is in place (Hooton et al., 2010). In Europe, indwelling urinary catheters are broadly used with an estimated 15% to 25% of inpatient adults having a catheter in place for part of their hospital stay. The prevalence of indwelling urinary catheter

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placement is even higher (45%–79%) in adult critical care units in the United States (Dudeck et al., 2013). The burden of CAUTI is significant in western countries where it affects from 5% to 15% of inpatients in general hospital wards and more than half of patients in critical care units. The U.S. Centers for Disease Control and Prevention estimates that approximately 1.7 million people develop HAIs annually; CAUTI contributes more than 30% of the total HAIs (Hooton et al., 2010). Low- and middle-income countries (LMICs) with limited resources for health care have not allocated resources for surveillance or prevention of CAUTIs, leading to the unknown prevalence and inadequate prevention (Strasheim et al., 2015).

The purpose of this article is to describe the methods and findings of a study that examined the prevalence of CAUTI at a regional referral hospital (RRH) in western Uganda. We start with a background section that reports the state of current knowledge about risk factors and the prevalence of CAUTI in general and in Uganda specifically, followed by methods, analysis, and results. We conclude with a discussion section that compares the prevalence of CAUTI at the study site with other global reports and makes specific policy recommendations to implement CAUTI surveillance and prevention strategies.

Background

CAUTI refers to symptomatic urinary tract infection in individuals who had indwelling urethral catheters in place within the 48 hours prior to symptom onset (Nicolle, 2014). The infection may be acquired during the process of catheter insertion, throughout the management of the indwelling catheter, or in the course of specimen collection when the closed system is temporarily breached (Dudeck et al., 2013; Hooton et al., 2010). The risk of acquiring catheter-associated bacteriuria is 5% for each day the catheter is in situ beginning with the fifth day; this increases to 100% when the urethral catheter is in place for 4 weeks (Nicolle, 2014). Catheter-associated bacteriuria refers to the presence of bacteria in the urinary tract of patients with indwelling urethral catheters without signs of infections such as increased body temperature and inflammation of the bladder (Hooton et al., 2010). Additional signs and symptoms indicate that the presence of bacteria has caused an infection. When the bacteria cause an infection, an increased likelihood of morbidity such as discomfort, septicemia, and increased length of hospital stay occurs. These consequences may be especially burdensome on the resource-constrained health systems in LMICs. Importantly, inappropriate antibiotic use related to CAUTI is a chief source of antibiotic-resistant organisms seen in hospitals around the world (Sievert et al., 2013).

Owing to the limited health care resources in LMICs, the World Health Organization (WHO) recommends specific CAUTI prevalence research in this setting to adapt and validate surveillance protocols that can be feasibly implemented (Nejad, Allegranzi, Syed, Ellis, & Pittet, 2011). In Uganda and other developing countries in sub-Saharan Africa, the burden of CAUTIs is still underestimated or even unknown because local health ministries do not allocate resources to conduct CAUTI surveillance activities (Nejad et al., 2011). Patients at government-owned and operated regional referral and general hospitals in Uganda routinely have urethral catheters placed. Yet, scant data exist about the prevalence of CAUTI or its related costs to the health care system or to patients. Hence, in accordance with the WHO recommendation, the aim of this study was to test an affordable and accessible means of CAUTI prevalence surveillance suitable to the resource-constrained health system in Uganda and to determine the prevalence of CAUTI among hospitalized patients at the study site.

Contexts of Care in Uganda

About two thirds of all Uganda health services are delivered through the Uganda National Health Service (UNHS), with the remainder being delivered through private not-for-profit and for-profit providers concentrated in urban settings (Alliance for Health Policy and Systems Research, 2017). About 70% of the Uganda population lives in rural areas. The UNHS spends about $8.20 (USD) per capita annually to support the National Minimum Health Care Package, while the international target for such packages in LMICs is $84 (USD) annually (Uganda Ministry of Health [UMoH], 2016), illustrating the underfunding of the public health system in Uganda. The underfunding may contribute to the extreme shortage of health workers throughout the country; in 2018, there were 3,645 doctors in Uganda (0.9 per 10,000 people) and 25,305 nurses and midwives (6.3 per 10,000 people; World Health Organization, 2018). The UMoH (2016) reports 13% to 20% vacancy rates for government-employed nurses and 43% vacancy for doctors

The UNHS delivers the National Minimum Health Care Package to more than 39 million Ugandans through a hierarchical referral system, where each progressive level offers services available at lower levels and adds more resource and service availability. Services from the government facilities are delivered to residents of Uganda without required payments from patients to the extent services and supplies are available. Stock-outs of essential medical equipment and services occur

frequently with half of the public facilities reporting missing components of the essential medicine and health supplies identified by the Uganda Ministry of Health (2016). Where stock-outs occur, patients are required to procure their own supplies by direct purchase at private pharmacies for the facility health workers to use. Uganda lacks a national universal health coverage scheme, and only about 5% of Ugandans participate in private health insurance (Nabuzale, 2018) that could help defray the costs of private or public health service.

The referral health system structure begins with volunteer village health teams that provide health promotion and primary prevention care to individuals. The next level is Health Center IIs (HC-II, 1,690 in the country) that are staffed by enrolled practical nurses and nursing assistants and then Health Centers IIIs (HC-III, 953 in the country) that are staffed with registered nurse-midwives and clinical officers (nonphysician providers). At this level, maternity, inpatient, outpatient, and laboratory services are provided. The highest level health centers are HC-IVs (171 in the country); they are mini-hospitals staffed with physicians (medical officers of the UNHS) and nurses who provide emergency surgery (Alliance for Health Policy and Systems Research, 2017; UMoH, 2016). The UNHS hospitals in the country are designated as general hospitals (45 in the country), RRHs (14 in the country), and national referral hospitals (1 medical and 1 psychiatric in the county), each providing progressively more comprehensive and specialty services (UMoH, 2016). The patients within the hospitals may be referred through the formal referral system or they may self-refer. Owing to the referral system, patients in the RRH are generally very ill, and there are frequent overcapacity conditions in the RRHs where occupancy rates are greater than 100% (UMoH, 2016). There were 7.8 inpatient overall hospital admissions per 100 people in the total population during fiscal year 2016–2017; the primary disease processes leading to hospital admissions are communicable diseases (malaria, human immunodeficiency virus infection [HIV]–acquired immune deficiency syndrome [AIDS], pneumonia, tuberculosis, and diarrheal illnesses) and trauma events (road traffic accidents; UMoH, 2016). Patients admitted to hospitals do not have direct access to toilet facilities; they must use basins at their beds or have indwelling urinary catheters to facilitate bladder emptying.

Methods

We employed a descriptive quantitative design to answer the research question: What is the prevalence of CAUTI among patients with indwelling urethral catheters at the hospital? The research ethics committee of the researchers' academic institution granted study approval in accordance with international standards for the protection of human subjects in research.

Setting

The study was conducted at a government-owned and operated regional referral teaching hospital in western Uganda. The hospital offers preventive, curative, and specialized health services with an official bed capacity of 350, although it frequently serves more patients than the stated capacity. Adult patients within the emergency wards, surgical, medical, maternity, and intensive care wards, who had indwelling urinary catheters in place served as the population for the study. In this setting, patients receiving care in emergency departments are classified as inpatients because they are admitted to the emergency departments through referral transfer from lower tier government-operated facilities or through transfer from medical or surgical units within the hospital when their condition requires a higher level of care only available in the emergency ward such as oxygen delivery.

Participants

The participants were adult (18 years and older) hospital patients who had indwelling urethral catheters in place during the immediate past 48 hours. Inclusion criteria required that a participant has a sufficient level of consciousness to be able to localize pain. To prevent confirmation bias, participants were not told the purpose of the assessment criteria, such as suprapubic palpation (Gray, Grove, & Sutherland, 2017).

Instruments

The outcome variable of interest was CAUTI among hospitalized patients. To accurately determine the presence of CAUTI in this western Uganda RRH resource-limited setting, we used three validated study instruments for each participant: (a) body temperature, (b) urinalysis for leukocyte esterase (LE)/nitrite (NIT), and (c) suprapubic tenderness on palpation. These study instruments were administered by the primary investigator, who had received training in the application of the infrared forehead thermometer, suprapubic palpation technique, and interpretation of the urine dipstick test. The consistent application of the instruments helped to assure consistency and reliability of the data (Gray et al., 2017).

According to the American Urological Society, individuals are diagnosed with CAUTI if they meet the following criteria: (a) temperature higher than 38°C, indicating a systemic inflammatory process, (b) a urine dipstick test that is positive for LE or NIT confirming the presence of microorganisms, and (c) suprapubic

tenderness showing local inflammatory process (Averch et al., 2015). We did not perform urine cultures to identify microorganisms of CAUTI. This is because we wanted to fulfill the intent having a sustainable surveillance system that has the ability to quantify CAUTI prevalence while being affordable, reliable, and realistic for a LMIC resource-limited setting.

Temperature. The body temperature was measured using a single forehead infrared thermometer (Braun no touch + forehead thermometer, NTF 3000, Kronberg, Germany). The manufacturer recommends inspection once a year, and this was done before data collection to ensure accurate readings. Temperature data were collected specifically for this study by the primary investigator. The thermometer probe was positioned about 1 in. from each participant's forehead, midway between the eyebrow and the hairline. The scan button was then pressed, and the participant temperature readings recorded. The infrared thermometer was chosen for its low cost and high validity and reliability in approximating body core temperatures rapidly (Duncan, Bell, Chu, & Greenslade, 2008). In the LMIC resource-limited setting, cross-infection would be high risk for oral, rectal, or axillary measurements owing to needing disposable sheaths or probes that require disinfecting between patient use.

Suprapubic tenderness. The single primary investigator employed the standardized assessment strategy according to CAUTI Assessment Profile (Blodgett, Gardner, Blodgett, Peterson, & Pietraszak, 2015):

> The rater exposed the participants' skin between the umbilicus and the mons pubis, then using the pads of the first, second, and third fingers of the dominant hand, the researcher palpated the lower abdomen. Palpation was not deeper than two centimeters to prevent discomfort that might be interpreted as pain. Areas of palpation were between: the roughly ovoid shape bounded by the umbilicus superiorly, the superior aspect of the mons pubis inferiorly, and the iliac crests bilaterally. The abdominal midline and an imaginary line were drawn between the two anterior superior iliac spines to divide the region into four quadrants. Each quadrant was palpated once, as well as the point of intersection formed by the two imaginary lines.
>
> This technique is favored because it ensures the use of physiological landmarks to identify the area overlying the bladder that would have been identifiable on adults with normal or near-normal anatomical features. (Abnormal anatomical features might have included abdominal hernia, evidence of surgical manipulation of abdomino-pelvic organs [e.g., abdominal hysterectomy, ileal-conduit, colostomy], or morbid/super-morbid obesity). This technique also provided a consistent depth of compression to prevent the potential effect of false-positive suprapubic tenderness due to blunt force instead of an inflamed bladder. (pp. 5–6)

Verbalization of pain or a motor response of at least flexion of the limbs indicated the presence of tenderness.

Urinalysis. Urinalysis to determine the presence of LE and NIT in the urine of participants was done using the urine dip stick at the participants' bedsides. Because the urethral catheters available at the government hospitals in Uganda do not have sampling ports, an open technique was used to collect the urine sample aseptically according to clinical guidelines (Perry, Potter, & Ostendorf, 2013). Using aseptic technique, the catheter was clamped for 10 minutes to allow urine to accumulate in the catheter. The point of connection between the urethral catheter and collection bag was cleaned with alcohol swabs and then disconnected for allowing 5 ml of intraluminal urine to collect into urine specimen bottle. The bedside dipstick test was performed by dipping the strips into the urine. We interpreted the results according to the instructions of the manufacturer. The Chemstrip dipstick (Roche Diagnostics, Montreal, Quebec, Canada) is a 2-minute procedure to detect LE activity as an indicator of pyuria and urinary NIT production, the indicators of bacteriuria. A positive urinalysis result occurred when either the LE test or NIT test or both were positive. A positive NIT test indicated that NIT had been produced from the reduction of nitrate by enteric bacteria.

Sampling Process

We targeted a sample size of 68 participants to achieve 95% confidence interval by applying an estimated 23% CAUTI prevalence rate reported in other LMICs (Hulley, Cummings, Browner, Grady, & Newman, 2013). On one random day of each of 4 consecutive weeks in March and April 2018, we invited every patient at the RRH who met the inclusion criteria to participate in the study. A member of the research team (who was not a care provider on the ward) approached each eligible participant to explain the study and invite their participation; their confidentiality was assured as no names were used in the study, only anonymous codes. Potential participants were advised they could withdraw from the study any time and that participation or nonparticipation would not affect the services they received at the RRH. Each of the study participants provided written informed consent to be part of the study. This process resulted in four data collection days, each a different day of the week to minimize bias introduced by repetitive

days (Sun 18, Mon 26, Wed 4, and Sat 14). Data were collected from 8 a.m. to 1 p.m. on each day of data collection. No participant repeated in a subsequent collection date, reducing the concern of systematic sampling bias and to maximize sample heterogeneity and internal validity (Gray et al., 2017).

Statistical Methods

CAUTI prevalence was calculated using the total adult patient population with an indwelling urethral catheter as the denominator. Chi-square tested for relationships between CAUTI prevalence, the duration of catheterization, and specific participant characteristics. All statistical calculations were completed using SPSS v.20.

Results

Participant Characteristics

A total of 68 participants took part in the study. The majority of the study participants were female ($n = 37$, 54%). Most of the study patient-participants were recruited from the emergency ward ($n = 22$, 32%). The mean age of the participants was 44 years. Documentation in the medical record provided the insertion date for the catheter, the total dwell time of the catheter in each of the participants ranged from 2 to 8 days ($M = 5.01$, $SD = 1.74$).

Prevalence of CAUTI

Of the 68 participants, 12 met the three-pronged criteria for CAUTI. During this 4-week surveillance (March 18–April 14, 2018), the prevalence of CAUTI in the study RRH was 17.6%. There was a statistically significant relationship between the duration of the urinary catheter and the occurrence of CAUTI, $\chi^2(1) = 7.57$, $p = .006$. Patients with longer catheter days had higher rates of CAUTI ($n = 11$, 16%) compared to patients with shorter catheter days ($n = 1$, 2%).

Discussion

The prevalence of CAUTI at the study RRH is high (nearly 18%) compared to a prevalence of nearly 6% reported from a longitudinal global epidemiology report of CAUTI from 70 countries tracing the prevalence between 2003 and 2013; only one of the countries contributing to this study was in sub-Saharan Africa, Ghana (Tandogdu et al., 2016; Wagenlehner et al., 2016).

Similar to prior reports in other settings (Chitnis et al., 2012; Dougnon et al., 2016; Gardner, Mitchell, Beckingham, & Fasugba, 2014; Lo et al., 2014; Nicolle, 2014), CAUTI is a widespread nosocomial infection among hospitalized patients worldwide. Congruent with prior literature (Dougnon et al., 2016; Nicolle, 2014), our results indicated that CAUTI rates are higher in patients whose urethral catheters have stayed longer compared to patients who had a shorter duration of indwelling catheterization. We confirm that the longer the catheter stays in situ, the higher the probability of developing CAUTI.

This high prevalence of CAUTI at the study site may be attributed to ineffective hygiene practices in relation to catheter handling, placement, and maintenance by health workers or to a more generalized and systemic problem of ineffective infection prevention practices. For example, Niyonzima, Brennaman, and Beinempaka (2018) found low rates of hand hygiene practice and compliance among health care workers at a RRH in Uganda. They reported that health workers in a government RRH in Uganda had limited access to running water and that the limited availability of soap for hand washing on awards contributed to low rates of hand hygiene practice and compliance among health care workers. To gain full understanding of the factors that contribute to the prevalence of CAUTI, further research is needed regarding health worker knowledge regarding indications for urinary catheterization and CAUTI prevention practices. The RRH infection surveillance specialists should conduct further laboratory studies to isolate the prevalent microorganisms that cause CAUTIs. This information could also facilitate proper antibiotic usage.

The high rate of CAUTI in this study may also be due to health care policymakers in Uganda considering surveillance and prevention as low public health priorities and hence not allocating sufficient resources for these activities. Strasheim et al. (2015) reported that inadequate surveillance of HAIs and inattention to patient safety and health care quality by policymakers in developing countries has contributed to high incidences of HAIs such as CAUTI. They postulated that health system policymakers in developing countries emphasize maternal and child health outcomes and communicable disease control, such as HIV/AIDS, malaria, and tuberculosis, at the expense of improving the quality of care and patients' safety in hospitals (Strasheim et al., 2015). This may contribute to the reported high incidence of CAUTI in this study. In turn, HAIs, such as CAUTI can lead to adverse outcomes such as antibiotic resistance, septicemia, and prolonged hospital stays complicating recovery for the patients and increasing costs to the hospital and patients (Kang et al., 2011).

Limitations and Generalizability

We acknowledge several limitations to our study. First, we used one RRH in one low-income country. Hence, our findings are not generalizable to hospitals in other

parts of Uganda or to other LMICs. Data collection was limited to 1 month; seasonal or temporal fluctuations may occur altering the prevalence rates of CAUTI through the calendar year, for instance, the rainy seasons result in higher rates of debilitating malaria.

The instruments used to determine the presence of CAUTI included the self-report of pain during supra pubic palpation, which is a subjective measure. Hence, some participants may have underreported or overreported the presence of pain. An attempt was made to objectively verify pain by observing for facial grimaces or limb flexions. Other studies may use different criteria such as urine culture confirmation to determine the presence of CAUTI, limiting the ability to directly compare prevalence rates between studies. Finally, collecting the temperature at a single time in the morning may have limited the potential to capture temperature rises that occur at other times of the day.

Policy Implications

Uganda has been a member of the International Health Partnership of the WHO aimed at improving health care quality performance and evaluation since 2009 (Boerma & Gore, 2010). The UMoH maintains a health policy advisory committee (HPAC) in pursuit of quality measures; however, the measures published of hospital quality are bed occupancy rates, maternal deaths, stillbirths, and deaths for patients under 5 years of age (UMoH, 2018). The findings of this study about the specific care sensitive health outcomes of CAUTI should inform the Uganda HPAC to recommend to the UMoH implementation of ongoing prevention and surveillance activities within the RRHs. This study demonstrated that this nurse-led surveillance program is low cost and feasible to implement. Expanding this surveillance role to nurses will effectively increase the education and awareness of CAUTI and the evidence-based prevention strategies. This can be achieved by HPAC recommending to the UMoH to support inter-professional hospital infection prevention committees and ensure the resources are present that this study employed to carry out CAUTI surveillance, which are urine dipstick tests, infrared thermometers, and training to assess supra pubic tenderness.

Our findings prompt us to make policy recommendations aimed at reducing the high CAUTI infection rate at the RRH where we conducted our study. First, we recommend that a strong and effective intraprofessional infection prevention committee appoint a surveillance team to continuously monitor the levels of CAUTIs in the RRH. This process is suitable for the resource-constrained health system in Uganda. Monthly surveillance captured in the wards with paper checklists that are transferred to electronic spreadsheets will show adequate trends and provide a baseline to measure improvements achieved through process improvement initiatives.

Second, the hospital infection committee should be empowered with enough resources to carry out surveillance of HAIs and to plan for interventions aimed at reducing HAIs. Such interventions would adapt the international evidence-based CAUTI prevention bundles (McNeill, 2017) to the local context with protocols and guidance for establishing written criteria for placement and discontinuation of urinary catheters to be posted on all adult wards of the RRH.

Third, the Uganda health system monitoring and evaluation plan should expand the currently measured hospital quality outcomes from admission and specific mortality rates to include patient safety needs. In Uganda, like many LMICs, the quality of health care and patient safety is given low priority compared to specific outcome measures that correspond directly to the United Nations' (2019) Sustainable Development Goal (SDG) III that focuses on reducing maternal and infant mortality, and reducing deaths from malaria, tuberculosis, and HIV/AIDS in LMICs. The importance of measuring these critical SDG outcomes cannot be over stated; however, inpatient hospital safety issues like HAI prevention have the potential to contribute to a reduction in death rates from these communicable diseases. The primary reasons for hospital admissions in Uganda are the same conditions that SDG targets for reductions in mortality. Improving the care for all patients with these conditions will have positive effects on reducing the mortality and morbidity from the targeted conditions. To reduce these nosocomial infections that contribute to mortality rates, health policymakers and stakeholders should prioritize activities geared towards inpatient safety.

Nurses and nursing students constitute the largest proportion of health workers present at patients' bedsides in the RRHs. The hospital chief nursing officer should empower the nurses and nursing students to engage with a robust infection prevention committee and establish nurse-led and evidence-based CAUTI detection surveillance and CAUTI prevention protocols to reduce the high prevalence of CAUTI in this RRH.

Conclusion

This is the first report of a CAUTI prevalence study using affordable and readily available resources in a LMIC resource-limited setting. Demonstrating the feasibility and effectiveness of surveillance to document the problem of CAUTI in this setting is an important first step to establishing a systematic surveillance and prevention routine. The high prevalence of CAUTI and the low cost of the resources used in this surveillance program

should convince health policymakers and policy stakeholders in Uganda and other LMICs of the need and value of a monitoring and prevention program for HAIs. Based on the high rate of CAUTI in this sample in the LMIC setting, health policymakers in LMICs should continue surveillance and reinforce international guidelines about limiting urinary catheter use to specific conditions and applying decision triggers to remove catheters at the earliest appropriate time to limit the occurrence of CAUTI.

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Declaration of Conflicting Interests

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References

Alliance for Health Policy and Systems Research. (2017). *Primary health care systems (PRIMASYS): Case study from Uganda, abridged version*. Retrieved from WHO website: https://www.who.int/alliance-hpsr/projects/alliancehpsr_ugandaabridgedprimasys.pdf?ua=1

Averch, T. D., Stoffel, J., Goldman, H. B., Griebling, T. L., Lerner, L., Newman, D. K., & Peterson, A. C. (2015). AUA white paper on catheter associated urinary tract infections: Definitions and significance in the urological patient. *Urology Practice*, *2*(6), 321–328.

Blodgett, T. J., Gardner, S. E., Blodgett, N. P., Peterson, L. V., & Pietraszak, M. (2015). A tool to assess the signs and symptoms of catheter association urinary tract infection: Development and reliability. *Clinical Nursing Research*, *24*(4), 341–356. doi:10.1177/1054773814550506

Boerma, T., & Gore, F. (2010). *Strengthening monitoring and evaluation practices in the context of scaling-up the IHP+ compact and Country Health Systems Surveillance*. Retrieved from WHO website: https://www.who.int/healthinfo/country_monitoring_evaluation/Uganda_CHeSS_report_final.pdf

Chitnis, A. S., Edwards, J. R., Ricks, P. M., Sievert, D. M., Fridkin, S. K., & Gould, C. V. (2012). Device-associated infection rates, device utilization, and antimicrobial resistance in long-term acute care hospitals reporting to the National Healthcare Safely Network, 2010. *Infection Control & Hospital Epidemiology*, *33*(10), 993–1000.

Dougnon, T. V., Bankole, H. S., Johnson, R. C., Hounmanou, G., Toure, I. M., Houessou, C., ⋯ Baba-Moussa, L. (2016). Catheter associated urinary tract infections at a hospital in Zinvie, Benin (West Africa). *International Journal of Infection*, *3*(2), e34141. doi:10.17795/iji-34141

Dudeck, M. A., Weiner, L. M., Allen-Bridson, K., Malpiedi, P. J., Peterson, K. D., Pollock, D. A., ⋯ Edwards, J. R. (2013). National Healthcare Safety Network (NHSN) report, data summary for 2012, Device-associated module. *American Journal of Infection Control*, *41*(12), 1148.

Duncan, A. L., Bell, A. J., Chu, K., & Greenslade, J. H. (2008). Can a non-contact infrared thermometer be used interchangeably with other thermometers in an adult emergency department? *Australasian Emergency Nursing Journal*, *11*(3), 130–134. doi:10.1016/j.aenj.2008.05.003

Gardner, A., Mitchell, B., Beckingham, W., & Fasugba, O. (2014). A point prevalence cross-sectional study of healthcare-associated urinary tract infections in six Australian hospitals. *BMJ Open*, *4*(7), e005099. doi:10.1136/bmjopen-2014-005099

Gray, J. R., Grove, S. K., & Sutherland, S. (2017). *Burns and Grove's: The practice of nursing research*. St. Louis, MI: Elsevier.

Hooton, T. M., Bradley, S. F., Cardenas, D. D., Colgan, R., Geerlings, S. E., Rice, J. C., ⋯ Tenke, P. (2010). Diagnosis, prevention, and treatment of catheter associated urinary tract infection in adults: 2009 International clinical practice guidelines from the Infectious Diseases Society of America. *Clinical Infectious Diseases*, *50*(5), 625–663.

Hulley, S. B., Cummings, S. R., Browner, W. S., Grady, D. G., & Newman, T. B. (2013). *Designing clinical research*. Philadelphia, PA: Lippincott Williams & Wilkins.

Kang, C.-I., Song, J.-H., Chung, D. R., Peck, K. R., Ko, K. S., Yeom, J.-S., ⋯ Kim, Y.-S. (2011). Risk factors and pathogenic significance of severe sepsis and septic shock in 2286 patients with gram-negative bacteremia. *Journal of Infection*, *62*(1), 26–33.

Lo, E., Nicolle, L. E., Coffin, S. E., Gould, C., Maragakis, L. L., Meddings, J., ⋯ Yokoe, D. S. (2014). Strategies to prevent catheter associated urinary tract infections in acute care hospitals: 2014 update. *Infection Control & Hospital Epidemiology*, *35*(S2), S32–S47.

McNeill, L. (2017). Back to basics: How evidence-based nursing practice can prevent catheter associated urinary tract infections. *Urologic Nursing*, *37*(4), 204–206. doi:10.7257/1053-816X.2017.37.4.204

Nabuzale, K. (2018, November 7, 2018). The case for a national health insurance scheme, Opinion. *New Vision*. Retrieved from https://www.newvision.co.ug/new_vision/news/1489042/national-health-insurance-scheme

Nejad, S. B., Allegranzi. B., Syed, S. B., Ellis, B., & Pittet, D. (2011). Health care associated infections in Africa, a systematic review. *Bulletin of the World Health Organization*, *89*(10), 757–765. doi:10.2471/BLT.11.088179

Nicolle, L. E. (2014). Catheter associated urinary tract infections. *Antimicrobial Resistance and Infection Control*, *3*(1), 23.

Niyonzima, V., Brennaman, L., & Beinempaka, F. (2018). Practice and compliance of essential handwashing among healthcare workers at a regional referral hospital in Uganda: A quality improvement and evidence-based practice. *Canadian Journal of Infection Control*, *33*(1), 33–38. Retrieved from https://ipac-canada.org/photos/custom/CJIC/IPAC_Spring2018_Niyonzima.pdf

Perry, A. G., Potter, P. A., & Ostendorf, W. (2013). *Clinical nursing skills and Techniques* (8th ed.). London, England: Elsevier Health Sciences.

Sievert, D. M., Ricks, P., Edwards, J. R., Schneider, A., Patel, J., Srinivasan, A., . . .Fridkin, S. (2013). Antimicrobial-resistant pathogens associated with healthcare-associated infections summary of data reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2009–2010. *Infection Control & Hospital Epidemiology*, *34*(01), 1–14.

Strasheim, W., Kock, M. M., Ueckermann, V., Hoosien, E., Dreyer, A. W., & Ehlers, M. M. (2015). Surveillance of catheter-related infections: The supplementary role of the microbiology laboratory. *BMC Infectious Diseases*, *15*, 5–5. doi:10.1186/s12879-014-0743-5

Tandogdu, Z., Bartoletti, R., Cai, T., Cek, M., Grabe, M., Kulchavenya, E., . . .Wagenlehner, F. (2016). Antimicrobial resistance in urosepsis: Outcomes from the multinational, multicenter global prevalence of infections in urology (GPIU) study 2003–2013. *World Journal of Urology*, *34*(8), 1193–1200.

Uganda Ministry of Health. (2016). *Annual health sector performance report*. Retrieved from http://health.go.ug/content/annual-health-sector-performance-report-201617

Uganda Ministry of Health. (2018). *Statistical review of progress to inform the mid-term review of the Uganda Health Sector Development Plan 2015/2016 – 2019/2020*. Retrieved from http://health.go.ug/sites/default/files/Uganda%20HSDP%20MTR%20analytical%20Review%20Report-%20FINAL%2024.10.2018_1.pdf

United Nations. (2019). *Sustainable development goals*. Retrieved from https://www.un.org/sustainabledevelopment/

Wagenlehner, F., Tandogdu, Z., Bartoletti, R., Cai, T., Cek, M., Kulchavenya, E., . . .Wagenlehner, F. (2016). The global prevalence of infections in urology study: A long-term, worldwide surveillance study on urological infections antimicrobial resistance in urosepsis: Outcomes from the multinational, multicenter global prevalence of infections in urology (GPIU) study 2003–2013. *Pathogens*, *5*(1), 1–8.

World Health Organization. (2018). *The 2018 update, Global Health Workforce Statistics* (Global Health Observatory data repository). Retrieved from http://www.who.int/hrh/statistics/hwfstats/

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