E-SURVEILLANCE SYSTEM (ESS) OF HEALTHCARE-ASSOCIATED INFECTIONS IN YOGYAKARTA INDONESIA

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Abstract

Healthcare associated infections have become a key performance indicator for a hospital quality. Surveillance Infections are the main challenge for infection preventionists (IPs). They have transitioned over time to assume a greater confined vicinity in a massively expanded scope of IP responsibilities. Infection surveillance used to measure success of contamination prevention and control programs, to become aware of areas for improvement, and to meet public reporting mandates and pay for performance goals. The aim of the research to make software electronic surveillance. Hope the e-Surveillance is regularly growing in infection prevention and manipulate programs. Methode for this research with DRM (Design Research Methodology). Result from this study, produce a software e-Surveillance System (ESS) for monitoring incidence and prevalence Healthcare-Associated Infections in hospital. Conclusion this research has been make software to make easy for implementation e-Surveillance System in hospital.

Keywords: E-Surveillance System, HAIs, Infection Control

Introduction

The purpose of the infection prevention and control program is to handle cases of infections that occur in hospitals, also known as *Healthcare-associated infections* (HAIs). Throughout the entire world, *Healthcare associated infections* have become a key performance indicator of hospital quality measures. For over two decades, HAIs have been a major issue of patient safety in regards to healthcare (Allegranzi *et al.*, 2007). Healthcare associated infections affect hundreds of millions of patients throughout the world each year (WHO, 2009). According to Kleinpell (2008) HAIs is an infection that appears during a patient's treatment at a hospital and begins to show signs of infection over the course of 48 hours since the patient was first treated. This is a major issue, considering a quality hospital's main focus when providing medical treatment is its patient safety application. Patient safety application is the means of providing services that promote patient safety, therefore if a patient were to acquire an infection during their treatment, the hospital must take responsibility of their health service performance in order to uphold their quality.

The number of infections continue to rise each year, starting with 1% in a handful of countries located in Europe and the US, to over 40% in Asia, South America, and Africa. According to data procured by *World Health Organization* (WHO), the number of HAIs incidents in hospitals is around 3-21%, with an average occurrence of 9% (DepKes RI, 2010). HAIs is currently becoming a main focus when providing medical treatment. It has been reported that illnesses caused by HAIs in lower middle-income countries include surgical wound infection 29,1%, urinary tract infections 23,9%, blood circulation system infection 19,1%, ventilator-associated pneumonia 14,8%, and 13,1% of other infections (WHO, 2011). Out of all illnesses as the result of HAIs, surgical wound infection is accounted to occur at the highest number.

Hospital-acquired infections (HAIs) are infections acquired when providing healthcare services during medical procedures and treatments. HAIs extends the length of a patient's stay which raises medical expenses, meaning a financial loss for the patient. The most effective way to reduce the spread of HAIs is by practicing *hand hygiene* (HH) in adherence to the rules that have been distributed. Results from a preliminary study

conducted by Dr. Iskak Tulungagung in the ER of RSUD uncovered that hand hygiene compliance among ER nurses was merely 30%. Further results reported that the average hand hygiene compliance among nurses was 36% with the highest compliance to the rules being taking place before the aseptic procedure (50%) and the lowest taking place after coming in contact with the patient (20%). Therefore, the factors that most affect hand hygiene compliance among ER nurses are knowledge, facility, and role model. Increasing medical staff awareness has been determined as the solution most likely to raise compliance. This can be accomplished through hand gel sanitizer examinations, yielding evidence of the effectiveness of hand hygiene by reducing the number of bacteria on the hands. It is to be expected that the determined solution will raise hand hygiene compliance if supported by the hospital, allowing the enhancement of facilities and the implementation of a reminder system through posters or role models (Pratama *et al.*, 2015).

One method that can be used to obtain data of infection incidents in hospitals is by conducting *surveillance*. The findings of the *surveillance* will be used as quality indicators from the prevention and control program, since they are capable of identifying the proper steps needed to reduce HAIs (Reilly *et al.*, 2001). *Surveillance* is defined as the means of systematic data collection and the diagnosis, analysis, as well as interpretation of important medical data for the planning, execution, and practice evaluation of public health. *Surveillance* allows for a way to identify and clarify a quality problem, pinpoint the cause, and later establish the correct performance improvement plan, which is the main agenda of *clinical governance* in a hospital. The parameters that can be used as indicators of HAIs are infections that can be identified through medical devices such as the IV, catheter, and ventilator, which are capable of causing phlebitis, *Urinary Tract Infection* (UTI), and *Ventilator Ascociated Pneumonia* (VAP), respectively.

The importance of *surveillance* in a hospital is that it requires for the manager of the hospital to find a more effective and efficient technique to conduct the surveillance. One form of application commonly used by hospitals with proficient hospital information systems is *electronic surveillance systems* (ESS). The results of ESS application could raise the quality of the infection prevention and control program in a hospital. At the minimum, implanting *electronic surveillance systems* (ESSs) will inform one of the hospital's characteristics through accumulating quantitative data that can be accounted for. It is to be expected that ESS users, nurses, doctors, and other hospital support staff will garner satisfaction after being able to know their hospital service performance. The hospital can ensure that the ESS program is carried out at its maximum. Hence, this research is much needed, especially for hospitals looking to receive accreditation from the Joint Commission International (JCI).

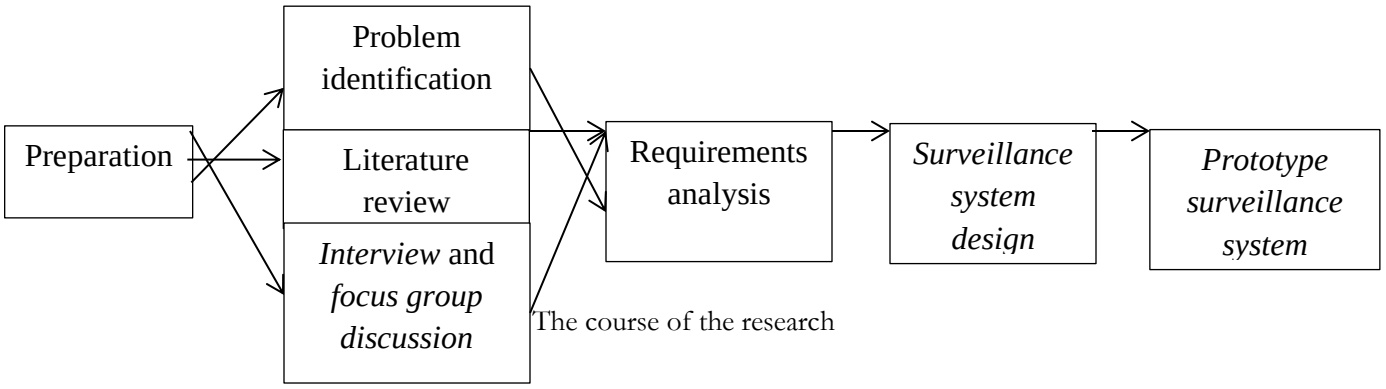
Seeing the importance of surveillance, this research will apply a surveillance system that will ease a hospital in collecting data in order to quicken its evaluation process, as well as raise employee compliance, particularly their compliance to wash their hands. Microorganisms found on the surface of the skin and around one's surrounding area are capable of causing multiple human infections. This is where the role of antiseptics, its function being to get rid of and hamper the growth of microorganisms on skin surfaces, come into play and is a crucial aspect in the prevention of infections (Levinson, 2008). Furthermore, Ward (2003) states that the majority of nosocomial infections in medical treatment are through an employee's hands due to lack of washing hands or an inadequate practice of washing and drying hands (Barbacane, 2004). Islam advocates one to always keep clean because Allah loves cleanliness, as mentioned in this verse of the Al Qur'an :

"... In it there are those who want to purify themselves, and God loves a clean person (Q.S. At-Taubah: 108)"

The aim of this research is to realise the infection prevention and control program by improving employee compliance, specifically regulations to wash hands, and so that the data of documented infections in ESS is able to lower the number of infection cases in hospitals.

Methodology

This is an experimental research that utilizes a system information design in the form of a prototype system. This research was conducted in a series of stages, beginning with problem identification and requirements using primary and secondary sources. Primary source was in the form of problem identification regarding the need of surveillance systems in hospitals. Meanwhile, the secondary source was required data from the surveillance system and was attained through literature review, consisting of references and journals, which was then adjusted based on the actual conditions of the hospital through interviews and focus group discussions. Secondary sources include attached medical equipment, cause of infection indicators data, bacteria resistance in form of the bacteria species, and antibiotic sensitivity in the form of antibiotics data. After acquiring primary and secondary sources, the following stage was to conduct a requirements analysis and then to determine the design of the surveillance system. That was followed by building the prototype surveillance system. The prototype design was adjusted according to the results of the requirements analysis.



The course of the research

Results

This study begans with the identification of surveillance requirements in hospitals. The identification process is carried out by FGD with the nursing management and Infection Prevention and Control team. Other identification from literature review with expert. Result from identified requiments for e-Surveillance system as in table-1:

Table 1. Requirements analysis of e-*surveillance system*.

No	Requirements analysis
1.	Patient data
2.	Attached medical equipment
3.	Infection indicator data
4.	Culture data
5.	Bacteria data
6.	Antibiotics data

In accordance to the requirements analysis presented in table 1, the ESS requires patient data, attached medical equipment, infection indicator data, culture data, bacteria data, and antibiotics data.
While the data requirements of patients at home are as follows in table-2:

Table 2. Requirements analysis of patient data

Kategori	Rincian
Patient data	Medical record number
	Patient name
	Room

Based on the requirements analysis portrayed in table 2, the necessary patient data includes the patient's medical record number, patient name, and the room where the patient was being treated.

Data requirement of medical devices installaed in patient in hospital as in table-3

Table 3. Requirements analysis of installed medical devices

Kategori	Rincian
Installed medical equipment	*Urine catheter*
	Central venous catheter
	Endo tracheal tube
	Intra venous line

Based on the requirements analysis shown in table 3, the necessary medical equipment consists of *urine catheter, central venous catheter, endo tracheal tube* dan *intra venous line*. The additional data states the date of attachment and detachment of each medical equipment.

The results of requirement infection indicators that occur from the installation of medical devices are as follows intable-4

Table-4. Requirements analysis of infection indicator data

Installed medical devices	Type of infection	Indicator Infections
Urine catheter	Urinary tract infection	Constant need to urinate
		Burning sensation when urinating
		Frequent urinating in small amounts
		Haematuria
		Distinct smell of *urine*
		Fever, body temperature > 38^{o}C
		Hypothermia, body temperature < 37^{o}C
		Mental changes in adults
		Lethargy
		Pyuria (leukocyte esterase +, nitrate +, leukocyte urine > 10.000)
Central venous catheter	Blood circulatory system infection	Fever
		Shivering
		Hypotensi
		Apneu
		Bradycardia
Endo tracheal tube	*Ventilator associated pneumonia*	Fever > 38^{o}C
		Leukopenia or leucocytosis
		In patients of > 70 years of age, there is an alteration in with causes that are both known and unknown
		Sputum purulent
		Changes in sputum characteristics
		Excessive respiratory secretions
		Increased frequency of suctioning
		Cough appears or cough begins to worsen or dyspnoea or tachypnea
		Bronchial breath sounds are heard
		Bacterial culture +
		Decreased oxygen saturation levels, increasing ventilator demand
Intra venous line	*Phlebitis*	Pain
		Edema

Installed medical devices	Type of infection	Indicator Infections
		Eritema
		Fever
		Palpable venous cord
		Tenderness
		Eksudat
		Induration/Hardness
		Thrombosis
		Local coldness
		Infused slow/stopped
		Tissues damaged
		Impaired of function

Based on the requirements analysis shown in table 4, the indicator data corresponds to the medical equipment that are attached. Attaching urine catheter will give rise to a risk of urinary tract infection with symptoms corresponding to the indicator data as follows: Constant need to urinate, burning sensation when urinating, frequent urinating in small amounts, haematuria, distinct smell of urine, fever, hypothermia, mental changes in adults, lethargy, pyuria (leukocyte esterase +, nitrate +, leukocyte urine > 10.000). Attaching c*entral venous catheter* will induce a risk of contracting circulatory system infection with the following data indicators: fever, shivering, hypotension, apnoea, and bradycardia. Attaching *endo tracheal tube* will induce a risk of contracting *ventilator associated pneumonia* infection with the following data indicators: fever >38^{o}C, leukopenia or leucocytosis, n patients of > 70 years of age, there is an alteration in with causes that are both known and unknown, sputum purulent, changes in sputum characteristics, excessive respiratory secretions, an increase in the frequency of suctioning, cough appears or cough begins to worsen or dyspnoea or tachypnea, bronchial breath sounds are heard, bronchial culture +, as well as decreased oxygen saturation levels, which in turn, increases ventilator demand. Gargar *et al.* (2017) stated that attaching an *intravenous line* will give risk to phlebitis with data indicators as follows: pain, oedema, erythema, fever, palpable venous cord, tenderness, exudate, induration, coldness, infused slow/stopped, tissue damage, and impaired function.
Requirement of culture data infections HAIs, in table-5

Table-5. Requirements analysis of culture data

Category	Culture data
Requirements analysis of culture data	Blood
	Peritoneal fluid
	Urine
	Swab
	Sputum

As depicted in table 5, culture data utilized in *surveillance* consists of blood, peritoneal fluid, urine, Swab, and sputum.

Table 6. Requirements analysis of bacteria data

Category	Bacteria data
Requirements analysis of bacteria data	Enterobacteriaceae
	Staphylococcus aureus
	Pseudomonas aeruginosa
	C. difficile
	Enterococcus species
	A. baumannii
	Candida
	Staphylococcus
	Klebsiella pneumoniae

Category	Bacteria data
	Enterobacter aerogenes
	Escherichia coli
	Serratia marcescens

Table 6 relates the required bacteria data which includes Enterobacteriaceae, Staphylococcus aureus, Pseudomonas aeruginosa, C. difficile, Enterococcus species, A. baumannii, Candida, Staphylococcus, Klebsiella pneumonia, Enterobacter aerogenes, Escherichia coli, and Serratia marcescens (Daniel *et al.,* 2010).

Table 7. Requirements analysis of antibiotics data

Category	Antibiotics data
Requirements analysis of antibiotics data	Amoxilin
	Cefadroxil
	Amikacin sulfat
	Dibekacin sulfat
	Gentamicin sulfat
	Netilmicin sulfat
	Streptomycine sulfat
	Sefalosforin
	Cefepime
	Cefixime
	Cefoperazone
	Cefotaxime
	Cefpirome
	Cefprozil
	Ceftazidime
	Ceftizoxime
	Ceftriaxone
	Cefuroxime
	Penisilin
	Ampicilin
	Procain penisilin
	Betalaktam
	Imipenem, cilastin
	Meropenem
	Chlorampenicol
	Thiamphenicol
	Azitromicin
	Clarithromycin
	Erythromycin
	Roxithromycin
	Spiramycin
	Cyprofloxacine
	Levofloxacine
	Moxifloxacine
	Ofloxacine
	Pefloxacine
	Tetrasiklin
	Cotrimoxazole
	Clindamycin

	Colistin sulfat
	Fosfomycin Na
	Lyncomysin
	Metronidazole
	Vancomycin HCl
	Ethambutol
	Isoniazid
	Pyrazinamide
	Rifampicin
	Fluconazole
	Griseofulvin
	Itraconazole
	Ketoconazole
	Nystatin
	Acyclovir
	Entecavir
	Ganciclovir
	Lamivudin
	Methisoprinol
	Valacyclovir
	Albendazol
	Pirantel palmoat
	Chloroquine phospat
	Primaquine
	Sulfodoxine, pyrimethamine
	Metronidazole

Prototype E-Survaillance system(ESS)

Prototype E-Survaillance system was created with a variety of display menu based on the results of the requirements analysis in table 1, along with a few modifications to ease the user.

1. Start menu

   The start menu that appears after medical staff open the ESS page is the user sign in, which acts as a threshold to access the ESS (Figure 1).

Figure 1. ESS start menu

2. Patient data

The patient data displayed on the menu comprises the medical record number, the name of the patient, and the room where the patient was treated (Figure 2).

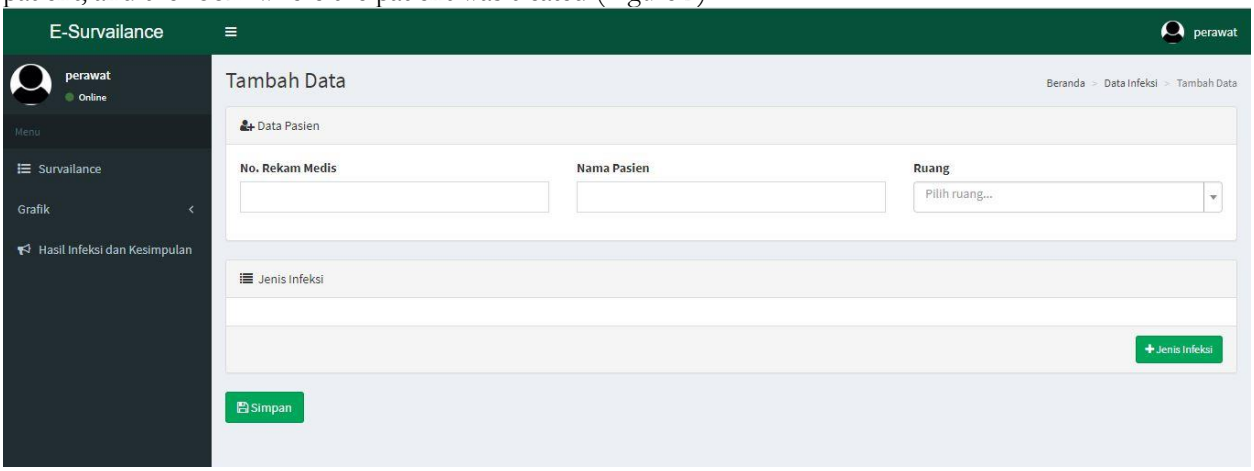
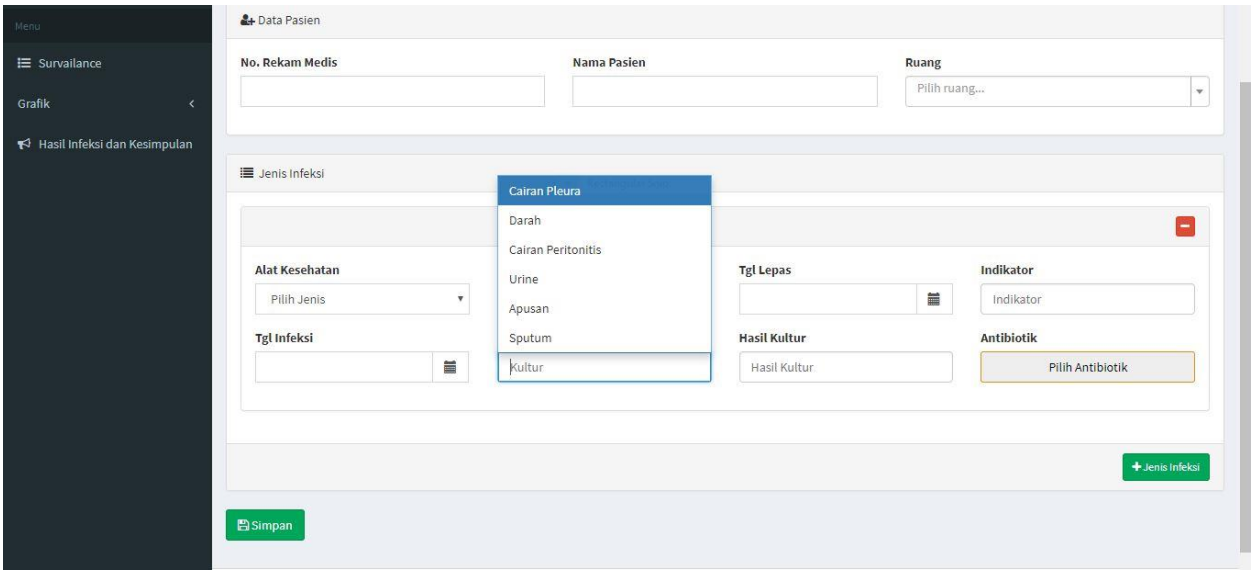


Figure 2. Patient data menu

3. Indicator data
    a. Data indicator for IV line
    b. Data indicator
    c. Data indicator
    d. Data indicator
4. Culture data



5. Bacteria data
6. Antibiotics data

Discussion

Surveillance in public health is described as "the ongoing, systematic collection, analysis, interpretation, and dissemination of data related to a health-related event for use in public fitness motion to reduce morbidity and mortality and to enhance health(1) Surveillance infection in hospital is the most important to prevent incidence in hospital (2)

The other about surveillance, make e-surveillance, for easy to investigate the cases.(2) Surveillance need modern ICT(2,3). Prevention infection very wide, so to (4) Surveillance is a Monitoring of overall

performance and behaviours as phase of ongoing production techniques is extra probably to take place in real time. The monitoring of private traits is extra in all likelihood to happen as a one-off event as a way of controlling get admission to to the organization. This can also take the form of physical access to organizational premises, or get right of entry to to roles within the organization through recruitment.(4).

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