



Data Handling and Transparency Enhancement in Central Sterile Service Department

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Abstract. Sterilization is the process of removal of impurities on the surface of an object. It is widely used in the medical field. It is a crucial department in every medical institute but it is least known to public. This paper gives an idea about security and satisfaction for patients ensuring the sterility of instruments used on them through cloud data management technology. Transparency in the sterilization is a necessity. Sterile Processing Department (SPD) is a part of a medical institute that takes care of maintaining sterilization of equipment which is commonly known as the Central Sterile Service Department (CSSD). A well-structured database system helps to handle this tedious process efficiently. Data collected from hospitals are stored in the cloud with a well-established data structure. People can get access to view the information from the cloud stored data related to them through a website/mobile app. With this system the patients are assured that they get operated with germs free equipment and the data are stored in an efficiently accessible manner.

Keywords: Sterilization · Central Sterile Service Department (CSSD) data · Cloud server · Hospital transparency · Patient satisfaction

1 Introduction

Sterilization is a broad phrase that can apply to any method of removing or killing any traces of biological/chemical contaminants [1]. This includes bacteria, fungi, viruses, and protozoans together with their reproductive structure forms that are sometimes terribly resistant. The chemical contaminant may be any by-products released by the above-mentioned contaminants which refer to life forms that are on the surface, at intervals a fluid, medications or compounds cherish buffers and culture media. Correct sterilization is well achieved with combos of heat, high pressure, filtration, chemicals, and irradiation [2].

The CSSD plays a significant role in patient safety associate degree in reducing hospital surgical infection [3]. From an infection management perspective, it's essential to make sure that the correct medical aid of surgical instrumentality is performed.

If instruments are microbial contaminated, this ends up in an inflated probability of contamination and succeeding infection of the surgical wound. CSSD is being a backbone in hospitals and in other health care facilities that perform sterilization and other actions on medical devices, instruments and, other consumables; for sequent use by physicians within the working department of the hospital and also for other sterile procedure, for instance, catheterization wound sewing and, medical care during medical, surgical, maternity or, medical specialty war [4].

The CSSD is split into 5 major areas: Decontamination, Assembly and Processing, Sterilizing, Sterile storage and Distribution. The process and results done by CSSD have been recorded and stored as data which is majorly used to examine the hospital's quality [5]. The data which we are planning to provide for patients are [6],

- Method of sterility
- Sterility level
- Set name and lot number of instrument pack
- Date of events

A cloud storage system can store different type of data. Cloud-primarily based architectures had been largely followed to reinforce and simplify the layout, the development, and the deployment of records structures, for collecting, processing, results, areas, and sharing medical records, medical institution administrative records [7]. These architectures help decorate the records series process (example, the worried entities are frequently supplied with cell person interfaces to cloud offerings for collecting and handling records). Furthermore, records sharing among hospitals and sufferers are likewise benefited; the layout of these structures frequently has safety and private aspects, which can be both taken into consideration as critical [8].

The Objective of the proposed work is, the set of information that we are said to provide will be stored in the cloud from CSSD through which we are collecting and providing the information to the patient in a precise way [9]. The data stored and extracted from the cloud finally reached the patients through the websites [10].

2 Related Works

The literature survey of the proposed works is discussed here. First, Ibrahim Abdulai Sawaneh and et al. developed patient database management in computer based system. This work is to store the patient data to maintain their medical records only for official purposes. However this paper doesn't mention the transparency provided to the patients. This downside could've been easily overcome by uploading the data to the cloud [11].

Second, Debabrata Basua and et al. is about the record and preservation period of CSSD data. This article majorly notified the importance of records maintenance in CSSD which enhances the knowledge of every hospital and in charge of CSSD about the importance but it doesn't shown out for the people. However, the latter doesn't mention about providing the same to the patients, which is a determining factor affecting the patient's satisfaction and transparency [12].

Third, Ritam Dutta and et al. proposed the concept of IOT based healthcare which promoted transparency. This work concentrates on the delivering the medical records to

the patients but this paper failed to deliver the complete transparency by not providing any data of CSSD [13].

Fourth, Reehan Ali Shah and et al.'s paper briefs about Intrusion Detection System (IDS), which is considered to be one of the main components in network security [14]. The article gives the statistical analysis on the infection rate due to sterilization [15, 16].

3 Central Sterile Service Department (CSSD)

Every day, several medical procedures are performed in intended facilities worldwide, with caregivers and patients hoping on the supply and use of a large variety of supplies, instruments, and equipment. These devices should be correctly cleaned, disinfected, and/or sterilized, inspected for quality to ensure good operating condition, and out there for care within the absence of proper handling, process, and storage, these devices could become contaminated and compromise quality patient care [17].

In most tending facilities, the Central Sterile Service Department (CSSD) plays a key role in providing the things needed to deliver quality patient care. To support infection management inside the tending facility, the CSSD employee members should be well-trained, skilful and committed to “doing what’s right” each step of the way [18]. This means making certain that shortcuts are created and that process and practices are systematically followed.

Consolidative reprocessing of reusable devices helps guarantee uniform standards of practice, whereas conjointly providing for improved progress (soiled, too clean, and too sterile). This also facilitates the coaching and education of skilled technicians who must be experienced with the standards, complexities, challenges, risks, and techniques related to the CSSD function. Each CSSD task should be performed in an exceedingly manner that protects the welfare and safety of patients, co-workers, and therefore the community.

Mistaking a step causes health hazards to patients. A part of Healthcare Associated Infection (HAI) is Surgical Site Infection (SSI) in which disease-causing living organisms enter into the human body directly and cause severe health infections. On an average SSI rate is around 5%-10% across different countries. SSI (Surgical Site Infection) is a part of Healthcare Associated Infection (HAI). Based on the survey conducted and research works previously done on SSI 8% result in the SSI. The report states that one-third of postoperative deaths are due to SSI. This percentage is high when seen on a large scale. 3 in 100 operations result in SSI. So in total 30,000,000 $((x/y)*z)$ patients get infected due to SSI.

This increases the length of hospital stay by 3–20 days per person. Patients have to spend extra amounts and their time. Costs of SSI is up to 10 billion dollar annually. In a growing economy the population is increasing in a rapid amount that demands many health care services. The connection between CSSD and people makes people aware of CSSD and their importance. It also becomes the responsibility of the hospital to show the patients that the equipment used on them is 100% sterile. To reduce infections and to increase safer health service to patients, a bridge between the sterilization department and people is to be built. Storage and maintenance of records about every instrument used in hospitals are done manually by employees in local systems/ servers or in written form [19, 20].

3.1 Procedures and Maintenance of Medical Equipment in CSSD

Sterilization process have been done around the world in three different types, Steam or Autoclave sterilizer, Hydrogen Peroxide (H_2O_2), Low temperature Gas Plasma Sterilizer and Ethylene Oxide (ETO) sterilizer. In all three methods a set of all packages are exposed to chemicals that kill the microorganism. Water at high temperature is used in steam sterilization. For plasma sterilization hydrogen peroxide is ionized and used and for ethylene oxide is used in ETO machine. After a particular time limit the chemical is removed and the surface is dried.

Specific Packaging and Wrapping. This department also provides the proper set for surgeries including the patient's dress, gaus, cotton, etc. These are the works performed by CSSD apart from sterilizing the equipment. Hence they are maintaining a large record of CSSD which has a precise content of the work of CSSD in Fig. 1.

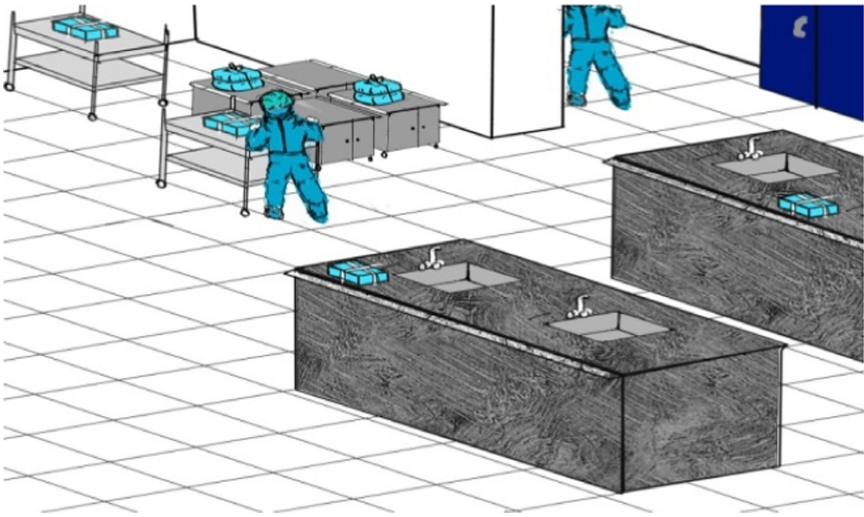


Fig. 1. Packing area in CSSD

Types of Indicators used to detect sterility: There are different classes of indicators available, in which Class I: process Indicator which is used to differentiate between processed and unprocessed units. Class V: Integrating Indicator which is a biological indicator used to detect sterility efficiently.

Types of biological indicator used for different sterilizers,

1. Steam- *Bacillus stearotherophilus*
2. Hydrogen Peroxide(H_2O_2) Low Temperature Gas Plasma - *Bacillus stearotherophilus*
3. Ethylene Oxide(ETO)- *Bacillus subtilis*

3.2 Data Management in CSSD

Every procedures and activities performed for every sterilized items must be documented and those records to be maintained which majorly used for inspection purposes, and also to track the process record information like: Daily production statistics to assess stock levels required for safe, continuous service, and efficient stock and cost control, All tests performed on equipment, Sterilization cycle records, Employee training records, Staff works rosters, Incident reports, Quality and procedure/ operational manual and Maintenance records [21].

Each item or pack intended for use as a sterile product must be labelled with a batch control identification which shall designate the following:

- Sterilizer identification number or code
- Date of sterilization
- Cycle or Load number
- Manufacturer’s batch/ lot number of any commercially prepared implant materials that are incorporated into the pack.

The records maintained for the sterilization cycle are:

- The date of cycle
- Code of the cycle
- Exposure time and temperature
- Specific content in the load. Example, linen packs, instrument trays etc.
- The readout result of physical, chemical and biological indicators that are used.

4 Cloud Data Management Technology

The Cloud data management technology is a method of storing our data securely. With this technology, we can store any data in a virtual space. Every organization, regardless of size or industry, needs a data center. A data center has traditionally been a physical facility used by business to store information and other applications critical to their operations. We say that a data center is one, but in reality, it is often stored with technical equipment on demand. From router security and security devices to storage systems and application delivery controllers [22].

Data centers also require huge amounts of infrastructure to keep all hardware and software up to date. These installations may include ventilation and cooling systems, uninterruptible power supplies, and backup generators. A cloud data center stands out uniquely in various ways than a traditional data center. These two computer systems are not the same except that they both store data [23]. Cloud data centers are all online and are not located in a particular organization’s office. When data is stored on clouds servers, it is automatically copied to multiple fragmented locations for safe storage.

We can store a wide amount of data in this virtual space and also it is possible to retain the data anywhere with the help of the internet. By using this cloud server method, there is no need of maintaining a dedicated server room for the particular organization since it is maintained by the cloud data service providers. It is possible to store any type of data

in the cloud regardless of what type of data it is. By comparing the dedicated server room maintenance, Cloud data server is a best alternative to store and maintain the data with the help of a service provider which will reduce financial stress and difficulties faced while storing data by the hospital. In the medical field, there is a need for storage space to store the medical history of the patients. Also there is a need for dedicated technology for the management purpose and of course to provide transparency of impatient data for customer satisfaction. Now, cloud data management technology gives a way to fulfil these requirements.

5 Proposed Work on CSSD

This research work aims to increase the awareness about CSSD among the patients. CSSD is one of the major departments which have valuable data which is often trifled with and is not known by many patients. The information about the sterility of the surgical instrument is of the same importance as the surgery details given to a patient. So we aim to give the data to the cloud. The data is collected from the records maintained by CSSD. Usually this data is stored in the form of a CSV (Comma Separated Value) file. To transfer a CSV file to cloud server we should first understand how we are going to use the stored data. Based on the requirement we can select deployment models namely: Private, Public and Hybrid. To collect data from CSSD and provide information to patients, a hybrid type of deployment model will be beneficial. So that data used only by the CSSD department can be stored in private servers and public can be used to store data that are given to patients.

After understanding the requirement, get storage space from cloud service providers in the market and upload the data in the cloud. The information from the cloud is given to patients by creating a tab on the hospital website with proper security measures. Patients can access their sterilization report from the hospital website by logging into the portal. Once the log in details entered by the patient's matches with the server data, a detailed report is generated from the stored information. Patients can get their report once the hospital allots a particular package of sterilized materials to the patient's treatment and that data is entered in the CSV file. It's shown in Fig. 2.

5.1 Steps Involved in Proposed CSSD Data Handling

For every Surgery, the equipment has to be sterilized and then used. Each sterile Equipment set has its own Unique Lot number or a code. After Sterilization for each set precise records are maintained by the Department. From those maintained records, Data which have Useful information for the patient are selected and uploaded as CSV which makes it easier to import and export it to cloud and other platforms. The data entered in CSV file is stored in a cloud from which patients are given access to view information by logging in with their patient ID provided by the Hospital management for them as shown in Fig. 3.

The technical sequence chart for the proposed work is given in the Fig. 4 and Fig. 5.

As we all know that python is a user-friendly language, we recommend Python for this process. We all know that python is a user-friendly language, which making it a

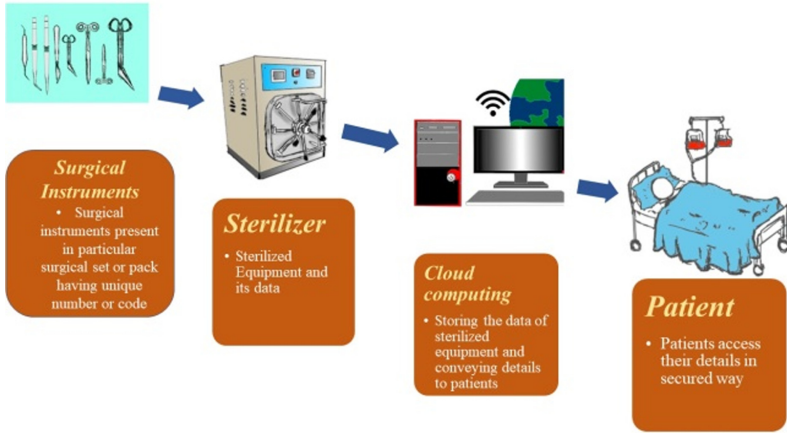


Fig. 2. Way of Approach for the proposed CSSD work

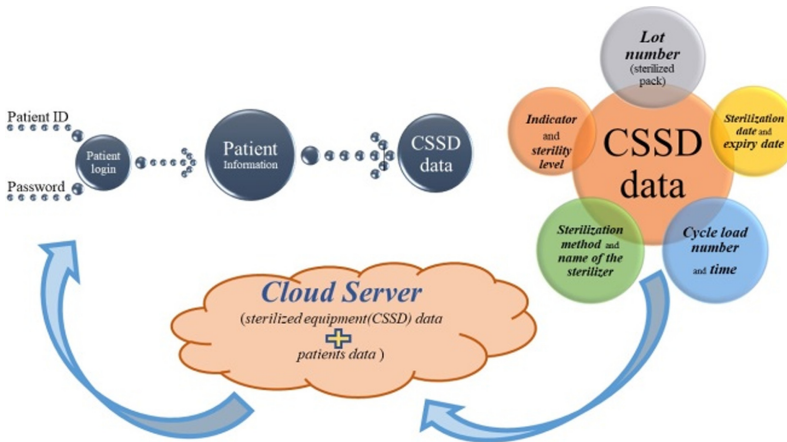


Fig. 3. Steps involved in CSSD Data transportation

reliable choice. In order to change the language from python to any other available languages like html, java, C, C++. the inbuilt functions vary drastically. If the order of execution is the same as python in any other language, a mere change in the inbuilt functions would enable the user to overcome the above-mentioned difficulties with ease. The changes mentioned in the question vary from language-to-language. Similar are the mentioned upgrades. Due to these reasons, they are not mentioned in the paper. Python has many inbuilt functions specially meant for data handling and performing mathematical operations which reduces time and gives accurate outcomes with less coding.

Algorithm for uploading CSSD data in cloud server.

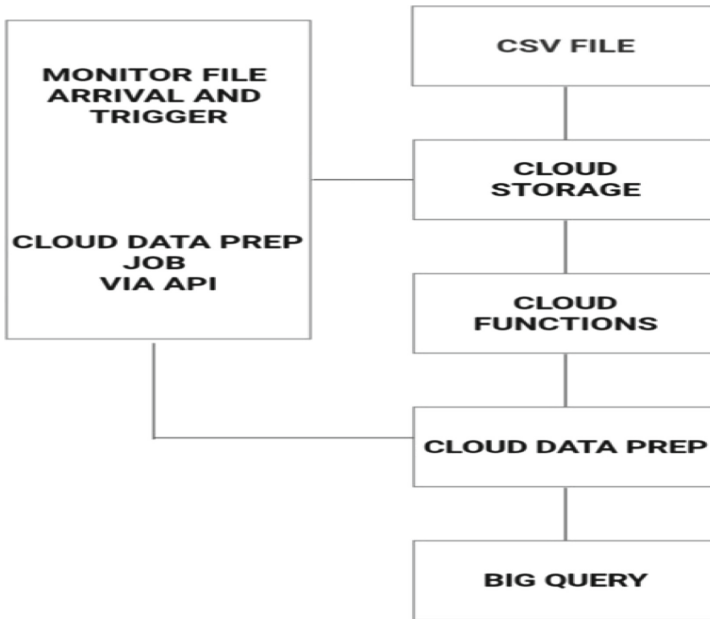


Fig. 4. Technical sequence chart for storing the data in cloud

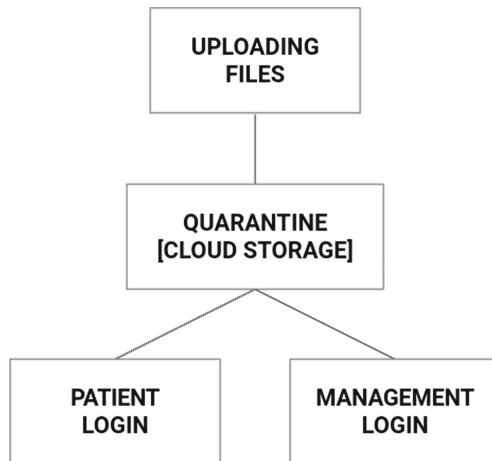


Fig. 5. Technical sequence chart for proposed work

Step1: Start

Step2: Server space for CSSD data entry is created

Step3: CSSD data (sterilized equipment) is uploaded as a CSV file in the server space.

Step4: A tab space is created on the hospital website to show the output for the data entered.

Step5: Security improvements are added to make the server secured.

Step6: Stop

Algorithm for fetching sterilized equipment's data from the cloud server for patient's satisfaction

STEP 1: Start the program

STEP 2: Enter the log in details given for patients from hospital as input

STEP 3: Read the csv file in cloud server

STEP 4: Print "Please wait your sterilization report is loading"

STEP 5: If input matches with stored data:

 Print "Data of the sterilized equipment from the cloud server."

 Else

 Print "your input doesn't match please contact the hospital"

STEP 6: Stop

Test cases of the proposed work is displayed in Fig. 6, Fig. 7, Fig. 8.

Patient Login

Fig. 6. Sample input

A survey was conducted in some selected hospitals based on the criteria mentioned below.

1. Hospitals having separate digital platform
2. Does the hospital have CSSD

The survey was regarding the connection between the CSSD and patients. By using some common metrics mentioned in the Fig. 9 the following results were obtained,

- Based on the survey more than half of the patients didn't know what is CSSD
- Similarly more than 65% of the respondents did not know the role of CSSD
- More than 3/4th of the respondents responded that their medical report has no details about the CSSD data

Patient details

Patient Name - Mr. ABC
Sex - Male
Age - 55
Patient ID - NDGDIKCBV
Surgery - Laparotomy
Surgeon Name - Dr. XYZ
Equipment's CSSD data - [PHD32468](#)



Fig. 7. Sample output 1

CSSD DATA

Lot number of the Set - PHD32468
Sterilization Date - 24/06/2021
Expiry Date - 1year (if not exposed in environment)
Time of Sterilization - 09:54:46
Sterilizer - Hydrogen peroxide gas Plasma sterilizer
Cycle number - 3
Indicator - Biological Indicator
Indicator Name - Bacillus stearothermophilus
Indicator test result - Negative
Final Result - completely sterilized

Fig. 8. Sample Output 2

Existing CSSD process outcomes

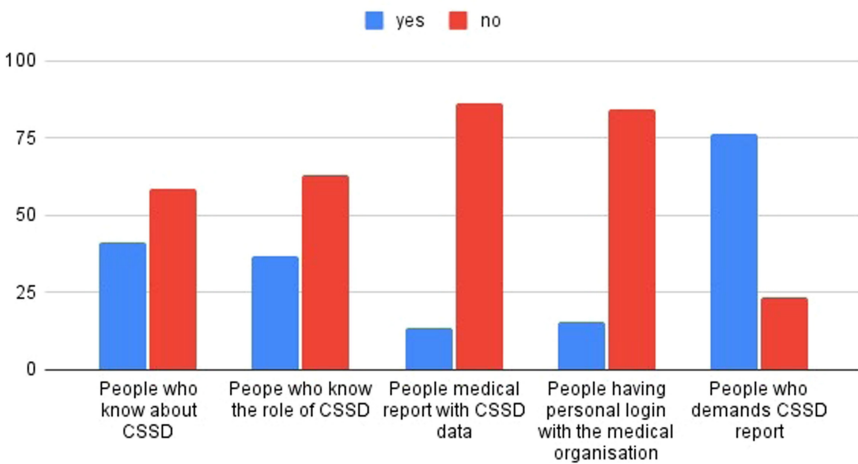


Fig. 9. Existing CSSD process outcomes based on survey

- Only 15% of the respondents have personal login with their Medical organizations
- Nearly 75% of the respondents favored the proposed work, that is, addition of CSSD data to the already existing medical records

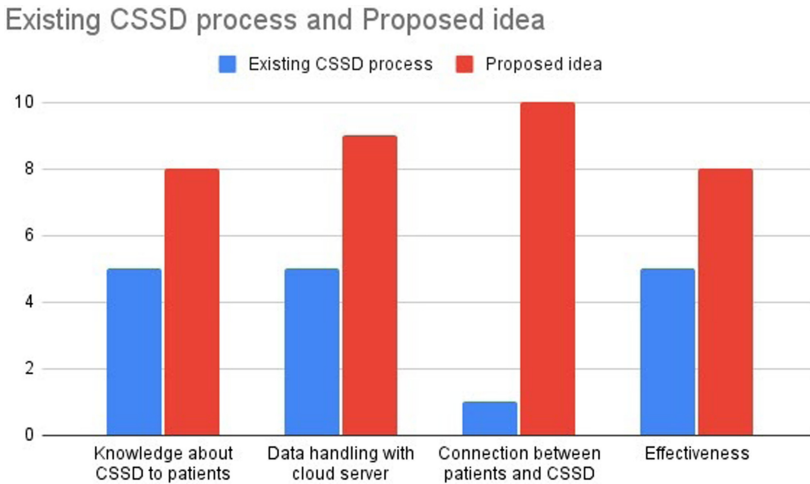


Fig. 10. Performance analysis of proposed CSSD with existing CSSD technique

The results accuracy of the proposed CSSD and Existing CSSD are measured with respect to the following Quality of Service Parameters.

- Knowledge about CSSD to patient,
- Data handling with cloud server
- Connection between patients and CSSD
- Effectiveness

The Fig. 10 depicts the Performance analysis of Proposed CSSD with existing CSSD technique. Knowledge about CSSD to patients in proposed CSSD work the skill rate is 8 out of 10. But in existing CSSD work the skill rate is 3 out of 10. Next parameter is Data handling with cloud server with respect to the utilization. The Proposed CSSD work utilized high utilization such as 9 scalability out of 10. But in existing CSSD work the utilization scale is low such as 5 scalability out of 10. Then Connection between patients and CSSD process patient satisfaction ratio 10:10. But in existing CSSD work the patient satisfaction ratio 1:10. The Effectiveness is the next parameter for the measurement of Proposed CSSD and existing CSSD technique. Based on Effectiveness the Proposed CSSD get the 8 profit out of 10. But in existing CSSD work the profit is 5 out of 10.

The data which the proposed idea to be provide can also be depicted as an Eq. (1).

$$E + P = D \tag{1}$$

Where,

E represents the Existing Data Provided to the patients.

P represents the Data to be added from the proposed idea.

D represents the final report to be provided for the patients from the proposed idea.

The Eq. 1 clearly depicts the Data handling of the proposed idea, that the data which planned to provide from the proposed idea for the for the enhancement and better bond between the patients and CSSD is the addition of Existing Data Provided to patients and the Data to be added about the CSSD in detailed manner.

Table 1. Distinguished between existing data provided to patients and data to be provided from proposed idea.

Existing data provided to patients	Data to be provide from proposed idea (Including existing data provided)
<ul style="list-style-type: none"> • Basic details of patients • Diagnosis report • Surgery plan • Surgeon details • Medicine details • Patient's laboratory results • Prescription report • Patient's hospital ID 	<ul style="list-style-type: none"> • Details of surgical equipment • Quality report of instruments used • Basic information of Sterilization • Detailed report of sterility • Step by step process of sterilization • Lot number of instrument sets

Table 1 explains the major importance of Sterilization and CSSD knowledge and showed the difference between existing data provided and Data to be provided from proposed idea. From this table we clearly get to know the basic knowledge of CSSD which also increases among the people and patients. This also helps to enhance the better connection between patients and Sterilization department. Therefore, it leads to the improvement in Sterilization work than now which encourages more sterility in everywhere. This reduces the number and risk of medical error due to sterility.

6 Conclusion and Future Direction

Work done by Central Sterile Service Department (CSSD) is the basis for every single medical procedure performed in a hospital. This department ensures safety by sterilizing instruments. Letting people know about this department enhances the performance of the department. Reduces SSI to a significant amount. It creates a connectivity link between people and CSSD. The structure stated in this paper provides an effective data handling system for CSSD in a secured and gives assurance to the public. The future direction of the work is to develop as a real-world cloud environment.

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