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Database management systems in the healthcare sector

SCDT44 – Assignment One

Table of Contents

[Introduction 1](#_Toc29230817)

[The role and suitability of Database Management Systems in the Healthcare sector 1](#_Toc29230818)

[Relational Database Management Systems 1](#_Toc29230819)

[The Hierarchal Data Model 1](#_Toc29230820)

[Oracle 2](#_Toc29230821)

[The importance and effectiveness of information systems in the Healthcare sector 2](#_Toc29230822)

[Human Resources 2](#_Toc29230823)

[Staff Wages 3](#_Toc29230824)

[Security 3](#_Toc29230825)

[The importance of data security and quality in the Healthcare sector 4](#_Toc29230826)

[Blood Transfusion 4](#_Toc29230827)

[Data Breaches 4](#_Toc29230828)

[Opportunities for improvement within the Healthcare sector in relation DBMS and information systems 5](#_Toc29230829)

[SQL Attacks 5](#_Toc29230830)

[User Error 5](#_Toc29230831)

[Auto Updating 5](#_Toc29230832)

[Conclusion 6](#_Toc29230833)

[Bibliography 6](#_Toc29230834)

# Introduction

In any business or organisation, the proper storage and management of data is important. This is usually done through a DBMS (Database Management System), which is an essential tool for any organisation that handles data. While the database itself is what contains the data that needs to be used, the DBMS is the software that allows for the manipulation of, and interaction with said data. This can be done through a variety of components, including the collection of data structure types, the operators that will be used and rules to be followed to ensure the integrity and reliability of the data inside **(Codd, 1981)**.

# The role and suitability of Database Management Systems in the Healthcare sector

## Relational Database Management Systems

There is a plethora of types of Database Management Systems, all of which have their own benefits and drawbacks based on which scenario they are being used under. For the healthcare sector, selecting the right DBMS is important, as the data that will be contained within them is highly sensitive.

One such example of a DBMS type is the commonly used relational DBMS. This type revolves around the relation/connection between the different pieces of data stored within the databases. This is usually done using tables to layout and sort the stored data into their appropriate containers. These relational databases are not limited by size due to their method of storing data, as these tables can be hundreds, even thousands of columns wide and rows long. Most RDBMS (Relational Database Management System) software allows for the users to create these relational databases using the SQL (Structured Query Language) programming language **(Sumathi and Esakkirajan, 2007)**.

A commonly used RDBMS is “MySQL”, which is an open source DBMS being used by big companies such as YouTube and Facebook **(Mysql.com, 2019)**. While this DBMS is commonly used, is not suitable for the healthcare sectors due to its scaling limitations. Within organisations such as the NHS, the databases used will need to be constantly added to and adapted to ensure that they can be properly used. MySQL is not as well optimised for uses on very large databases, and so use of this RDBMS within the healthcare sector could impact its ability to run properly.

## The Hierarchal Data Model

Another example of a DBMS type is the Hierarchical data model. The hierarchical DBMS is designed around relationships between entities stemming from initial objects – with them filtering down, like that of a tree-diagram. The records that are stored each have a level and a “parent” – which is the record that proceeds it in the database **(Chand, 2019)**. This DBMS is mostly used for organisations such as banks where there is more of a focus on performance as opposed to adaptability.

While this DBMS has its uses in different scenarios, it is not effective for use in the healthcare centre. There is a big limitation with this database design in that adding new values or moving the location of existing values can completely redesign the entire table(s) – making it less user friendly. With the amount of content that would need to be added or edited in a scenario such as a hospital; the risk of the tables being constantly reformed can make everyday tasks more difficult.

## Oracle

Within the healthcare sector, there are a wide range of examples of where DBMSs can be used, as well as how their involvement affects the management of data. One such example is the “Oracle” DBMS that is used by the NHS, which has a heavy focus on autonomation. When a managing a database as large and as sensitive as those used in healthcare, being able to reduce chances of human error is important to ensuring that the data contained within it is accurate. This is one of the features of Oracle, is it claims to be the world’s first fully autonomous database **(Oracle.com, 2019)**.

# The importance and effectiveness of information systems in the Healthcare sector

## Human Resources

Within the healthcare sector, there are a range of scenarios where information systems are used. One of these is the data storage for the human resources department. One of the purposes for the HR department in any organisation is to resolve any concerns employees may have, with the business itself or other staff members. The HR department will not use just one database for managing the employees, as there are several uses for the storage and management of information in the department.

When storing the employee data in Human Resources, keeping certain parts confidential is important for employee privacy and security. “A wealth of data can be stored but should only be visible to staff on a permission-basis” **(Personnel, n.d.)**. Through storing the data within a manageable database, permissions can be set for those accessing the database through the information system as to what data can be accessed/viewed and what is unavailable. This is very effective for the management of the data security, as with the correct settings in place, the users would not be able to access data they don’t have permission for.

When it comes to managing concerns of the organisation’s employees, a database can be used to log the different complaints made, along with important information relating to them – such as the employee(s) involved and the status of the complaints’ completion. This is an effective tool for the HR department as making it easily identifiable as to which concerns have already been managed, can make the department more efficient.

## Staff Wages

It is a legal requirement for organisations to collect and keep records relating to their employees’ payroll **(GOV.UK, n.d.)**. Those within the healthcare sector are no different, with staff members having salaries that are needed to be recorded accurately so that the correct pay is received. There is a range of information systems that can be used for proper keeping of payroll, with the majority of these containing databases and the tools to manage them. With the large amount of information that would need to be stored within a payroll database, relying on physical medium is not a perfect system as parts can be lost or accessed by those who are unauthorised.

Organisations can face large legal ramifications if their employees are not paid the correct wage for what was agreed in their contract. The use of databases allows for bookkeeping of the history of the money paid to staff to be stored and managed. This is especially useful if an employee raises a query about the amount they have been paid, as the information stored in the database can simply be referenced to provide evidence.

## Security

While the storage of employee information can help prevent employees accessing data they don’t have permission to view, it doesn’t guarantee complete security over the information stored there. If access is gained to the information systems by unauthorised third parties through hacking and cyber-attacks, the sensitive information stored has the potential to be stolen and used maliciously. With the nature of the personal information stored within the information systems, if the data was stolen and sold on or used by the hackers, there is a large risk of the employees suffering from identify theft or the loss of their money. Information such as home addresses, phone numbers and credit card details have been shown to be enough information for transactions to be completed under the false pretence of it being the owner of said information, except in reality it’s someone who has stolen said information.

Having information systems be the way of storing personal information can be efficient for within the company, but similar to many online systems – once it has been breached by a third party, there is little to stop the personal information from being released into the wider world.

# The importance of data security and quality in the Healthcare sector

## Blood Transfusion

Due to the nature of the information being stored in databases within the healthcare sector, ensuring that they are both accurate and up to date is always a top priority. Services such as the NHS will often deal with people in matters of life and death, and so having medical information that doesn’t correctly associate with patients could cause them more harm.

One such example is the procedure of Blood Transfusion. “A blood transfusion is when you're given blood from someone else (a donor)” **(NHS.uk, 2018)** and is quite a common practice. For the procedure to work as intended however, there are certain factors that must be ensured so that there aren’t mistakes that could be costly for those involved. Making sure that the correct blood types are used in the transfusion is vital for the procedure to work, else there would be simply no effect or in some cases the patient would suffer an allergic reaction to the new blood in their system. The patients’ medical information would have been stored in a database(s) within the service’s system – and would have contained their blood type for the situation where new blood was needed. If the data stored within this database is outdated or outright incorrect, then the previously stated complications are more likely to arise.

## Data Breaches

Due to the nature of the information being stored in healthcare databases; ensuring the proper security is in place is vital **(Bertino and Sandhu, 2005)**. There are a wide range of employees within the healthcare sector, and so not of all them would have the need or the permission to access certain parts of the data stored there. This means that ensuring the proper measures are set up for stopping unauthorised users from accessing restricted data is important for the security and safety of the patients’ whose data is being stored. If unauthorised access is gained, then the data stored within can be stolen.

There are examples of data breaches within the healthcare sector that have resulted in people’s data being stolen and sold on the black market. With the case of Anthem Inc, a large health insurance company in the U.S, around 79 Million people’s private information was stolen through a breach in 2015. This breach resulted in a settlement payment of $115 Million – reported as the largest settlement amount up until that point. **(NBC News, 2017)**

# Opportunities for improvement within the Healthcare sector in relation DBMS and information systems

## SQL Attacks

While Databases and Information systems are widely used throughout the healthcare sector, there are still issues with their current design. The security of the databases is very important when it comes to the healthcare sector, or any organisations that store and manage people’s personal information. With a large market on the Dark Web for stolen personal information **(Stack, 2017)**, ensuring that the proper measures are in place to prevent its theft is vital. However, with the current design and implementation of databases within organisations – there are still weakness and limitations in preventing the attacks.

For example, many Database Management Systems use the programming language SQL, which can be vulnerable to a type of attack called “SQL Injection”. This attack is where the perpetrator is able to enter their own SQL code to break the set program and gain unrestricted access to the database(s) stored within. **(Halfond et al., 2006)** It can be difficult for patients in the healthcare sector to feel safe trusting organisations if the databases they are stored in aren’t secure.

This issue doesn’t apply to just DBMSs within the healthcare sector, as many websites and database systems are susceptible to this type of attack. This shows that this vulnerability is not an isolated incident, and so cannot be solved within the organisation itself. This shows that DBMSs as a whole have improvements that need to be made to help tighten security and privacy.

## User Error

User error is still a very prominent issues when using databases – even with more advanced DBMS systems, there is still the chance for those using them to make mistakes – whether it be in data accuracy or in security. An example of this would be the recent “New Year’s Honours” Leak. This leak occurred on the 28th of December 2019 where over 1,000 people’s personal information, such as home addresses, was accidently posted online by the government. The user is charge of the information made the wrong section of the database public, allowing visitors of the site to view data they were not supposed to **(BBC News, 2019)**. This shows that while security can be improved for the databases used for healthcare, there is still that chance that those using It will make mistakes.

## Auto Updating

One aspect of databases that can be improved in the future is the auto-updating features across the DBMS. As previously mentioned, it is important for the data across the DBMS to be accurate due to the nature of the information used within healthcare. While many DBMSs currently have features for the instances of data across the DBMSs to be synced to be accurate throughout – there is still room for improvement. The more improvements that are made to ensure consistency of data throughout a DBMS, the easier it will be to reduce any mistakes.

# Conclusion

The aim of this report was to identify and evaluate the uses of Database Management Systems and Information Systems within the Healthcare Sector. With important factors, such as user error and database adaptability, considered; the advantages and disadvantages have been laid out and compared. The different types of DBMSs have also been identified, laying out which are more suitable for use in healthcare and why others are better suited elsewhere.

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