



Quick Respond-Based Case Note Management System: A Case Study for File Record Unit

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ABSTRACT

The common and major problem with public hospitals in Malaysia is patients' case note management, which includes tracking and updating the details of the case notes daily. Currently, the hospital is still adopting the manual method of managing the case notes which is time-consuming and prone to human errors. This paper proposed a quick respond-based case note management system for a public general hospital in Malaysia. In this project, the Quick Respond code is used as an identification or tag for the case note when the staff is looking for the case note in the existing in-house management system. This is useful for reducing the steps of manual work by only scanning the QR code at the speed of a second. The proposed system contains three modules, that are QR code printing, QR code scanning, and reporting. Our findings show that the time needed to manage the case notes is reduced greatly with the deployment of the system. The system also managed to lighten the work burden faced by the nurses at the hospital.

Keywords:

Quick respond code; Patient case note management system; Quick respond tag identification

1. Introduction

The first Quick Respond (QR) code was invented by the automotive industry in 1994. It was purposely used to provide a convenient way for tracking the inventory in vehicle parts manufacturing but it has now become widespread in other fields [1]. QR code is a two-dimensional barcode that allows data storage in both horizontal and vertical directions unlike the one-dimensional barcode storing data in a horizontal direction. With this design, a QR code can hold a much greater amount of data in a smaller space and it can be read at high speed [2]. Due to the ability to contain rich information, QR code is convenient to use in tracking the information labelled on commercial products, name cards, sale of goods, post mailing, and any objects that require identification and information. The reason why it has become so popular in recent years is that it is a very cost-effective,

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reliable, and secure way to wrap information on any object. The information stored in the QR code can be quickly retrieved by an imaging device such as smartphones with any license-free QR decoding application that requires only small computation power [3]. Besides, the QR code is widely used nowadays due to the factor of rapid growth and development of smartphone accounts, QR code has become an integral part of us [4,5]. There are many types of management problems in various fields [6]. Since the QR code has become so popular in the public community, it has been widely used in many fields.

In education, QR code has been used to augment the education content for active learning methods [7,8]. For example, including the QR code inside the presentation slides reinforces the presentation contents by linking the relevant external resources such as articles, videos, or other relevant notes [9]. Consequently, it is common to see the usage of QR codes in online surveys. For instance, QR codes are used to share online survey links without the need to enter a long survey link into a web browser [10]. A study on the effectiveness of QR codes linked to the online survey form was done by Snyder *et al.*, [11]. They showed that the QR code method has the highest frequency and efficiency of respondent feedback in between the QR code-linked survey forms, paper-based survey forms, and online access survey forms.

For higher education institutions, the traditional student attendance method is very time-consuming. For example, the students need to write down their names or sign beside their names within a long list on the printed attendance sheet. To overcome this issue, a student attendance system using a QR Code was used by many institutions [12-14]. In Malaysia, it was first launched by Universiti Malaysia Sarawak [15].

In health care, the situation of overcrowded outpatient is one of the biggest problems, especially in public hospitals. If the patients spend a long waiting time in the hospital, it makes the patients have poor satisfaction with the quality of health care service [16]. The situation of overcrowding is not only dissatisfying for the patients, but also for doctors, nurses, and hospital staff because it appends a burden to their workload or even increases their stress level. This situation increases the possibility of making human errors in treatments [17]. The major cause of this problem is the limited resources such as doctors, nurses, and staff, and the limited capacities of medical devices. To overcome this problem, a system utilizing a QR code and a smartphone application is used to capture the process of hospital service by collecting the time spent on individual activities to identify and improve the bottleneck of the system [18-20].

It is widely known that the patient record is an ever-growing source of data as plenty of new patient records will be generated every day. Recording and maintaining patient records manually are very inefficient and time-consuming. It is also highly unreliable and the chances of getting human error become very high. In 2014, a Radio Frequency Identification (RFID) based conceptual framework for hospital management systems was proposed to provide an efficient channel to reduce manual procedures. The previous management system required manual identification key entry to access the system and manage data. To increase the productivity of daily work, the existing manual method has been replaced by scanning the RFID tags for identification [21]. However, the limitation of using RFID signal as mentioned in [22] stated that the installation of RFID needs more handholding software to process the RFID signal and retrieving data using the RFID tags is a tough procedure due to the antenna of the RFID receiver being tiny.

In 2016, a QR-based hospital patient record system was introduced in Turkey. Each patient record from the database is tagged with a unique QR code. The staff from the hospital only need to take out their phone or standalone QR code scanner to scan the QR code for collecting the patient information from the database without struggling to enter the identity number of case notes or patient name and phone number manually [23]. The QR identity tag system has been evaluated by [24]. The evaluation

results showed that the QR identity tag method is a cost-efficient method and useful to prevent medical errors as well as allows smooth access to vital medical information during an emergency.

In 2018, a QR-based hospital system was developed to obtain patient health records easily without the need for paperwork. They used the dataset and applied machine learning techniques to predict and estimate the type of disease based on patient symptoms. The predicted disease and patient information are wrapped into QR codes which will be sent to doctors for further action. This allows doctors to become easier in tracking the patient's health status using their smartphones [25].

Recently, QR codes have been applied to enhance the quality of the internal medicine packaging process such as preventing the staff from giving the wrong medicine to the patients [26]. After the patient's visit, the information of the patients and medicine details are encoded into a QR code that can be later read by a common QR code decoder in patients' smartphones even if no internet access. When the patients collect their medicine at the pharmacy, they can check all the medicines prescribed by the doctor to avoid man-made medication errors.

Due to the privacy issue, we will denote DK for the public hospital in Malaysia where we conduct our research. We are aware that the staff from the File Record Unit (FRU) of Hospital DK are still using the paper-based mechanism to keep track of and update the details of patients' case notes. Every day, they need to manage enormous case notes manually. This manual repetition can cause human errors that lead to an issue of deficiency in daily operations. Hence, we propose a QRCNM system to the FRU to minimize the manual workload of the staff to improve their daily productivity.

In the following section, we explain the methodology, that is how we are going to solve the problem and we shall present our proposed system to overcome the issues faced by the staff from FRU. The result and discussion of this project are discussed in Section 3 and followed by the conclusion in the final section of the paper.

2. Methodology

To overcome the problems faced by staff at FRU, a Quick Respond-based Case Note Management (QRCNM) system is proposed and used to minimize human error and overcome the time-consuming situation in daily workflow. The objectives of the proposed QRCNM system are:

- i. To tag case notes using QR code
- ii. To shorten and reduce the steps of the tracking process
- iii. To minimize human error in recording the tracking detail
- iv. To automate report generation

The proposed QRCNM system consists of three modules, namely QR code printing, QR code scanning, and Lampiran generation. The QRCNM system is a web-based system running internally within the hospital. The whole system is utilizing the existing database from STP and SRFP systems. The whole mechanism of the QRCNM system is to replace the existing manual process which is laborious and tedious but no means to replace the existing STP and SRFP systems. The QR system is using the same security standard as the existing systems and hence the same login credential will be used. Figure 1 shows the login interface for the staff to access the existing STP and SRFP systems.

The login interface consists of a white box with a light gray border. At the top, there is a 'Username' label above a text input field containing the placeholder 'Enter Username'. Below this is a 'Password' label above a text input field containing the placeholder 'Enter Password'. A green button with the text 'Login' is positioned below the password field. Underneath the login button is a checkbox labeled 'Remember me' which is checked. At the bottom left is a red button labeled 'Cancel', and at the bottom right is a blue link labeled 'Forgot password?'.

Fig. 1. Login interface

The first module is the QR code printing. It is used to generate a QR code for each volume of a case note. Note that this process is a one-time process where the FRU has to do only once to get all the case notes in the hospital and tag them with a QR code. Each generated QR code is unique. There are two options available for this module i.e. appointment-based printing (see the left panel of Figure 2) and selective printing (see the right panel of Figure 2). For appointment-based printing, staff can select an appointment from Lampiran 5 (L5), which is a list of case notes generated from the STP system and generate the QR codes. This option is useful if the FRU would like to progressively tag the case note with a QR code during the checking out of case notes. For the flexible printing option, staff can generate and print a particular QR code for a case note. This option also allows unlimited selection, group, and printing of a large batch of QR codes for the selected case notes. This module also supports a reprint when a QR code is damaged or faded.

Figure 2 shows two panels of the QR code printing interface. Panel (a) is titled 'PENCETAKAN QR KOD' and shows a search for 'Klinik Pakar' on '2024-08-20'. It displays a table with 2 entries. Panel (b) is also titled 'PENCETAKAN QR KOD' and shows a search for 'No RPP' with a table containing 1 entry. Both panels include a 'Menjana QR Kod' button at the bottom.

Nama Pesakit	No RPP
...	pmbu84XheLX
...	wjJA74W8ch

Nama pesakit	No RPP
...	z4NpiRPVpdTb

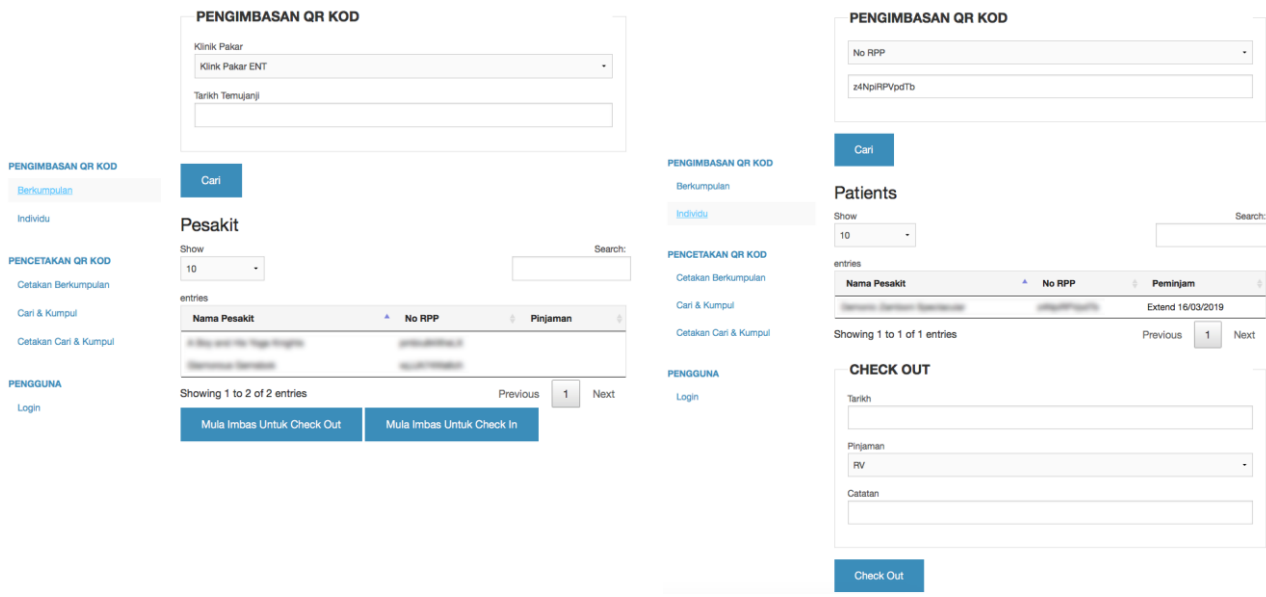
(a) appointment-based printing

(b) selective printing

Fig. 2. QR code printing

The second module is the QR code scanning. It is used to check in or out for a case note. There are two options available for this module, i.e. appointment-based and individual-based as shown in Figure 3. For appointment-based, staff will select the clinic and the appointment date to either check-in or out. For checking out a group of case notes within an appointment date, staff only need to input the remark once and start scanning for all the case notes. The remark will automatically be inserted

into all the related case notes. As compared to previously, there are four details required to manually input for each case note. Whereas for the case note check-in, the process becomes even easier. Staff only need to select the clinic and appointment date and start the continuous scanning to check in all the case notes at once. This process required no input apart from the QR scanning which takes less than one second for each case note. For the second option, individual-based, it is useful to check in or -out for a particular case note. The staff only need to scan the QR code in order to perform the checked-in or -out task. In the case of check-in, the appointment date and clinic will immediately be displayed. This allows the staff to locate the L5 easily, faster, and accurately, which has overcome the complication discussed in B4 mentioned in Section 3.



(a) appointment-based scanning

(b) individual-based scanning

Fig. 3. QR code scanning

The third module is Lampiran generation. The staff only need to select the respective clinic and appointment date to print out the L5. After the staff enters the required inputs, a complete L5 will be generated and ready for printing. Figure 4 displays the sample of QR code printing for a selected clinic and the appointment date.

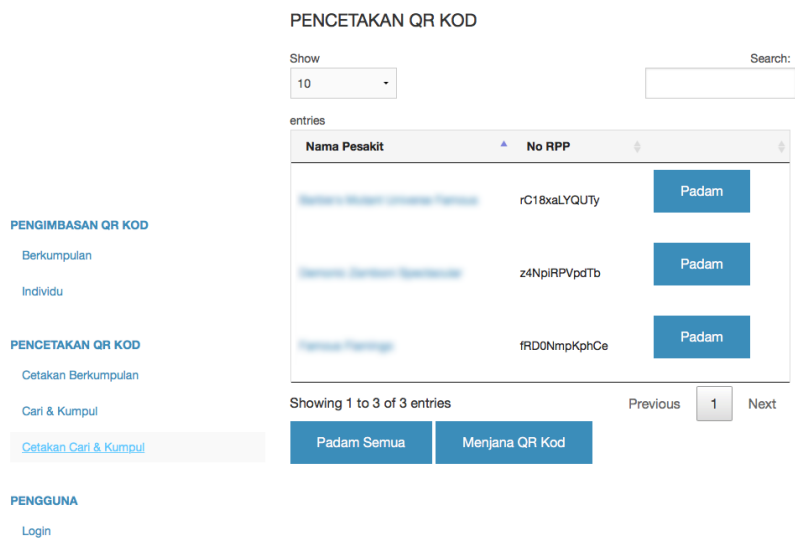




Fig. 4. Sample of QR code printing

3. Results

After the QRCNM system is deployed to the staff from FRU, the quality of work in FRU is evaluated. The evaluation result is summarised in Table 1. It shows that the spending time on case note management has been reduced significantly.

Table 1

Time comparison between using manual operation and using QRCNM system in case note management system

Activities	With manual operation	With QRCNM system
Generate L5 from the STP system	<ul style="list-style-type: none"> • 5 minutes per clinic • manually prepared from HTML to MS-Word 	<ul style="list-style-type: none"> • 2 seconds per clinic • automatically generated in the form of QR code
Searching and identify case note based on L5	<ul style="list-style-type: none"> • Manual searching • Time-consuming • L5 is not sorted alphabetically 	<ul style="list-style-type: none"> • Automated and computerised searching
Cross-checking the case note	<ul style="list-style-type: none"> • 72 seconds per case note • Manually remark check-out date at L5 • Manually remark appointment date at case note 	<ul style="list-style-type: none"> • 25 seconds per case note • Scanning of the QR code that tagged on the paper-based case notes
Transfer check-out details into SRFP	<ul style="list-style-type: none"> • 31 seconds per case note • Manual case note searching • Manually key in 4 details per case note 	<ul style="list-style-type: none"> • Automated

With the QRCNM system, the staff will no longer be required to key in the case note identifiers like identity card number or surname and do the manual search. Unlike previously, where the check-in/out process requires two steps. The first step is to cross-check on the L5 during the case note handover between the staff from FRU and the nurses from the respective clinic. The second step is

to transfer the details from the L5 into the SRFPS system. With the QRCNM system, the check-in/out process is completely done by only scanning the QR code that is already tagged on the paper-based case notes. Since the QR code system has reduced the number of manual inputs, it manages to reduce the number of manual inputs that has a high tendency to incur less human error. For the group or appointment-based check-out, the staff are no longer required to input many details for each case note. They only need to fill in once and the system will record and apply for the whole batch. For example, the staff only need to select the clinic and appointment date once and then scan the QR code without any additional input. The staff can perform continuous scanning to check in/out all the case notes at once. Besides, the conversion of L5 from HTML to MS Word format for printing purposes is not required anymore. The L5 can be automatically generated in the form of a QR code. Hence, the automated L5 generation has reduced the unnecessary workload. The generated QR codes can be printed using a normal printer and on common sizes of paper (e.g., A5, A3, etc.). The system is designed to be compatible with many common QR scanners and hence there is no specific hardware installation required. Therefore, this is a very cost-effective and convenient.

Table 2 shows the improvement of work quality in daily case note management after the QRCNM system was deployed. It shows that the QRCNM system helps increase the staff working productivity and reliability as the manual process is almost replaced by a digital system.

Table 2

Improvement of case note management using QRCNM system

Activities	Improvement
The 1-day workload for a clinic at FRU <ul style="list-style-type: none"> • Check-out 100 case notes • Check-in 100 case notes 	Reduce 1 hour each for a nurse from the clinic
The 1-day workload at FRU: transfer data to the SRFPS system <ul style="list-style-type: none"> • 700 check-out case notes • 700 check-in case notes 	Reduce 12 hours
Case Note Tracking Solution at FRU <ul style="list-style-type: none"> • Reduce human data entry into the SRFPS system 	Increase data accuracy

However, there are some constraints and limitations that remain. The advantage of the QR code deployment is mainly focused on the FRU, the nurses from each clinic still need to manually cross-check the process for each case note. Besides, the QR system is a web-based system, a set of computers with a QR scanner is required at the front desk for the daily task. Putting this equipment in the limited space at the counter will affect the smoothness of the operation. Also, the proposed QRCNM system is utilizing the existing database, which is running on a legacy server in the hospital. Hence, a new update and revamp on the STP and SRFPS systems is highly required and necessary to synchronise the data on the proposed QRCNM system with the existing database on the STP and SRFPS systems. Lastly, it is also noticed that the existing database is not optimised. There are a lot of redundancies in the database design which further deteriorates the speed.

4. Conclusions

This project proposed a quick respond-based case note management system for a public general hospital in Malaysia to help the hospital staff and nurses solve the problems faced by them. After the deployment of the system, the time spent by the staff and nurses on the case note management has been reduced significantly. Furthermore, the workload has also been reduced greatly. With these improvements, the system can be extended to other public general hospitals in Malaysia.

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