Thanks to digitalisation we have access to electronic patient-related data. Sadly, however, there are little or no integrated software solutions available to manage this data flow and support the organisation of the department. Using up-to-date software it is now possible to query waiting times through the database of the Radiology Information System (RIS). Unfortunately, this process provides historical information and is not a representation of the actual workflow processes, thus making it impossible to take action when needed. Moreover RIS data do not take into account staffing problems, patient load, x-ray device failure etc.

A possible solution to this problem could be to have a “guard” in the department. By this we mean a physical person, working as a waiting room manager, who checks waiting room occupancy, interacts
with patients, and inquires how long they have been waiting for already, and who is able to redirect patient flows in case of an x-ray device failure, or reallocate technologists depending on the workload. Such a solution would be expensive and is not foolproof.

We are convinced that it would be preferable to involve technologists in the workflow process, to empower them and make them “owners” of the production process. For such a solution to succeed, it is essential to share current and up-to-date information with the technologists (eg the number of patients in each waiting room, waiting times, number of expected patients etc.). This implies that there is a need for supporting software tools to collect the facts, and to integrate these data with scheduling software, RIS and PACS (Picture Archiving and Communication System). We are certain that visual reproduction of these data in a user-friendly setup would provide an additional benefit.

In our study, we started from the patient’s point of view. Upon entering the radiology department, the first step for every outpatient is to register for his or her examination(s). After registration, the patient is then directed towards a specific waiting room depending on the type of scheduled examination (chest x-ray, CT scan etc.). Even though this process is relatively straightforward, we are all aware that things can go wrong. Some outpatients do not understand the instructions they are given, or forget to which waiting room they have been assigned. As a result, some patients take a seat in a waiting area without knowing that they have made a mistake. They just wait until the technologist or nurse comes to escort them to the examination, and they are not aware that they will have to move to another waiting area.

Our purpose is to improve this process, and to that end we have explored three possible avenues:

1. Help (guide) patients to find their way by using ticketing and digital signage screens.
2. Visualise the occupancy of the different x-ray rooms by making use of digital dashboards.
3. Our global aim is to render patient throughput and production processes visible to management.

We decided to solve this problem by implementing a three stage solution:

1. Digital signage;
2. Ticketing;

At present, stage one is fully operational in our department. Every waiting area is equipped with a digital signage screen, which displays a video loop containing specific examination-related information for the patient as well as more general information about the radiology department and the medical staff (see Figure 1).

Stage two (ticketing) is partially implemented. Upon arrival at the reception desk, patients take a numbered ticket from a dispenser. They are called in a sequential order for registration in the RIS (by
numbered ticket from a dispenser. They are called in a sequential order for registration in the RIS (by ticket number). Currently these numbered tickets are thrown away after the patient has been registered. For the future it is our goal to include the ticket number in the RIS at procedure level. Procedures in RIS are linked to an examination room, and each examination room is allocated to a waiting area. After registration the ticket numbers appear on the digital signage screen in the allocated waiting area. In this way, patients have a visual confirmation of being in the correct waiting area. All the ticket numbers are displayed in a sequential order, which makes it possible to estimate waiting times.

Finally, in the third stage of the process, we need to create a waiting room dashboard, which will provide an overview of the different waiting areas, and allow the staff to evaluate patient throughput and workflow (see Figure 2). This third step will be implemented together with the RIS vendor.

![Waiting Room Dashboard](image)

The first horizontal line of numbers on the dashboard represents the different waiting rooms (1 to 6). The two-digit numbers beneath every waiting room number represent the ticket identifiers of the waiting patients. For example, in waiting room 2 there are three patients waiting for their procedure. These patients are identified by ticket number #31, #36 and #39. The partial circles, colour-coded from green to red, indicate how long each patient has been waiting. A full circle indicates a waiting time of one hour. So the patient with ticket number #31 in waiting area 2 has been waiting for approximately fifty-six minutes. The indication “Expected” at the bottom of the dashboard indicates how many patients are still expected in that particular waiting room; WT indicates the average waiting time.

This process can only become successful if positively received by patients and staff. In order to assess patient acceptance, we performed a pilot study through an online questionnaire via email after implementation of step 1 and partial implementation of step 2. A total of 1,002 patients were invited to supply feedback via e-mail; 122 emails bounced. Of the remaining 880 patients, 566 respondents completed the questionnaire (64.3%), 31 patients started the questionnaire, but did not finish it, and 314 patients did not reply. For the setup of the waiting areas and digital signage, respondents assigned an approval score of 92.1%. Patients greatly appreciated the examination-related information on the digital screens. Questions related to the reception desk welcome, ticketing and privacy received an approval score of 92.8%.

**Conclusion**

Controlling and improving patient workflow in a radiology department represents a formidable challenge. We conceived a project using digital signage, ticketing and electronic dashboards to improve patient throughput and workflow management. Even though our project has only been partially implemented, we are very happy to see the positive feedback from our patients. Further improvements can be achieved by fully integrating numbered ticketing within RIS, in order to guide patient flow. The creation of digital electronic dashboards is the next step, and it will be mandatory to integrate this process with existing software. We feel that the proposed three-step process is
integrate this process with existing software. We feel that the proposed three-step process is beneficial to our patients, and it also helps to render production processes visible to management.

**Key Points**

- Patients can be helped to find their way in a radiology department by using numbered ticketing and digital signage.
- Shared information about patient workflow, through electronic dashboards, helps to involve radiographers and to empower them as “owners” of the workflow processes.
- Digital dashboards, indicating waiting times and waiting room occupancy, give managers a tool to gain information “at a glance” of the production process in the radiology department.

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