Smart hospital – our experience

Velibor BOŽIĆ
MSc., Koprivnica General Hospital
E-mail address: informatika@obkoprivnica.hr

Abstract
Smart Hospital is an interesting concept with the help of which we want to improve the business processes in our hospital. The main processes are patient care and management, but all other processes in the hospital can be improved too. This text is a sort of case study and it tries to show how we in our hospital work in the context of "clever".

Keywords: Information-communication technology, smart hospital, e-health.

1. Smart hospital – what is it?

Smart Hospital [1] relies on:

- Optimised and automated business processes
- Excellent ICT environment (network speed, information security, cloud computing, big data, IoT…)
- Well - educated staff

Today, we are only partly "smart", but with the development of technology hospitals will become even smarter. Nowadays, we talk about e-health, a concept closer to reality. However, e-health is only one part of Smart Hospital.

2. How we do it?

There is a lot of literature about intelligent organisations [2]. The reason I mention this is because "if some organization wants to be smart it also has to be intelligent" (Sydanmaanlakka 167). Smart (intelligent) organisations – hospitals in our case – have to look for a way of improving their business processes, their learning capacity and they have to look for a way of increasing employee competencies. If we have better business processes and more competent employees, the users of our services will be more satisfied. As a result, the financial result will be better too.

A completely smart hospital does not exist because something can always be done better. Here, I will try to show how a hospital can be smart with the help of IT. We have some preconditions for a smart hospital.

- How does the board see IT?

If the board sees IT as an aid only, the hospital never will become smart. The main tasks of the IT department are not repairing printers, creating Excel tables etc. Sometimes this is also necessary, but it does not have to be the department's core mission. The main job of IT is to support the board in decision making, which is important for a successful management of all important processes in the hospital.

- Do we have an informatisation strategy?

The Ministry of Health of the Republic of Croatia brought a document called "Strategic Plan of Ministry of Health 2019 - 2021" [4] in which ICT is emphasized as crucial for fulfilling the goals of the strategy. The hospital board derived its vision from this document, as well as the hospital strategy and strategic aims. They are as follows:

- VISION: complete informatisation of the hospital
- STRATEGY (how we do that)
  - Get infrastructure (servers, PCs, active and passive net equipment, software…)
  - Horizontal and vertical integration (horizontal – within the hospital and between hospitals; vertical – with the Croatian Institute for Health Insurance (HZZO)
  - Make preconditions for linkage with other elements of the health system (primary medical care, Public Health Institute, pharmacies)
  - Make preconditions for linkage with other systems like the Croatian Pension Insurance Institute
- STRATEGIC AIMS (how to carry out the strategy)
  - Make a project for ICT infrastructure
  - Purchase the necessary equipment
  - Procurement of necessary information systems
  - Integration of information systems on data level using the HL7 (Health Level 7) protocol.
  - GAP analysis

Once we had a vision, a strategy and strategic aims, we analysed the existing situation – what we have and what we need to have. We identified where we stand and what we have to do in order to be a smart(er) organisation. The result of the GAP analysis is a document in which we listed everything about our resources (human, technical, which softwares we have, the number and characteristics of our servers, PCs, the condition of the net) and stated whether we have some standards. Furthermore, we described the main processes in the hospital and employee competences, as well as wrote about the patients' satisfaction with the provided service…). This document was the basis for improvements in our hospital.

3. Why are we a smart hospital?

Koprivnica General Hospital is smart because:

- All important business processes are ICT supported – they are connected to information systems and interchange data via these information systems. We have several information systems which are fully integrated on data level thanks to the HL7 protocol.

Here is a list of all information systems:

- Business information system (supports all non medical processes – procurement, accounting, cash balance, invoicing, cash flow…)
- Health information system (supports the main process in the hospital – patient care – from admission to release)
  - In this system, doctors record everything about the patient – course of treatment as well as diagnostics and specialist medical records. They have an archive of medical records. This system is used in surgeries and in inpatient care.

    - Part of this program are also modules for invoicing and for system administration.
- Laboratory information system (supports all activities in the medical-biochemical laboratory)
  The system increases [3] the efficiency and quality of the clinical diagnostics laboratory
- Radiology information system + PACS (a system for processing digitized radiological images) – supports and manages work processes in the area of radiation diagnostics and nuclear medicine
- A lot of medical equipment is connected with PCs through sensors or RS 323 connectors and all data from this equipment go to databases (first generation of IoT)

Besides these information systems we also have the following in our hospital:

- Telemedicine
- Application for transfusion medicine
- Application for nursing documentation
- BI
- Web www.obkoprivnica.hr
- Internal web (intranet) – the main channel of communication among employees, a kind of notice board).

What is smart here? Smart is the fact that all of these information systems are completely integrated. They communicate on data level using the HL7 protocol. The communication enables:

- Improvement of business processes - faster diagnostics

For example, the doctor sees the radiology image and record before the patient comes back to his surgery.)

- Error probability is minimised because there is no copying.
- Radiology, colonoscopy and gastroscopy images are instantly in the patient's archive.
- Improvement of employee efficiency – they can process more patients in the same amount of time.
- Data exchange is safer thanks to authentification and authorisation of every system user (ISO 27001:2013: ISO 9001:2015).
- Every night the data from transaction information systems are being copied on the so-called OLAP server. On that server, we have set reports for top management.
- In the health information system we have an archive where doctors can see the whole procedure concerning a patient. It is the patient's electronic health record. For now, it is only in our hospital and we do not exchange it with others because it is against the law. Technically, however, it is possible

In short, we can say that our hospital is smart because business processes are integrated and faster, unnecessary repetition of entering data is avoided, data are secure, errors are rare and we can always find out who made the error.

4. e-Health (vertical linkage with other institutions)

Up to this point, we talked about horizontal communication or communication inside the hospital. However, our hospital also communicates vertically with the Croatian Central

Health Care Information System (CEZIH), which is a system of the Croatian Institute for Health Insurance (HZZO).

We have to give HZZO the following information on a daily basis:

- Number of records for every surgery and doctor
- Financial realisation
- Waiting lists for some diagnostics or specialist activity
- Key performance indicators (number of patients per doctor, availability of beds in inpatient care, number of deceased, use of antibiotics …)
- For every patient, we send radiology and laboratory records to CEZIH (a general practitioner can always access medical records from CEZIH)

We send all of this information automatically, without any user intervention. We are also connected with the Public Health Institute and automatically send them inpatient statistics.

We can say that the hospital is smart because the process of booking a doctor's appointment for tests or operation is automated. No telefax, phones or e-mails are necessary. Doctors decide which dates and times are visible for a certain surgery and IT employees adjust them. General practitioners see them in CEZIH and can book appointments through e-booking.

Giving prescriptions is also automated. Information systems track a patient's medicine consumption and advise doctors on what is necessary in inpatient care. Furthermore, we are connected with pharmacies outside the hospital and can order medicine for the patient. This module is called e-prescription.

We have a module in the health information system which is directly connected with the Registry office. The e-newborn module enables registration of a newborn baby soon after birth. If our doctors are not sure about a diagnose, they can ask for another opinion via telemedicine.

Telemedicine also provides interactive lectures. Medical staff actively listens to and talks to a lecturer, who can be anywhere. This type of learning is referred to as e-learning. Every medical record of our doctors' patients goes to CEZIH automatically (e-records).

Our non-medical employees communicate via a service called e-citizen. Here we can work on anything connected with employment or licenses which are necessary for work with the Central Financial Agency (FINA) regarding salaries, length of service (for retirement) etc..

5. Conclusion

In the end, we can say that our health system is quite smart. E-communication between the hospital and CEZIH is on a high level because the law requires that. So far, we have e-booking, e-records, e-prescriptions. We are ready for EHR (Electronic Health Record), but there are some ethical issues concerning the protection of content. The challenge is to be "smart" inside the hospital. In that area, things are unequal.

In this text, I talk about the hospital in Koprivnica-Križevci county. Our institution is becoming smarter. The next step in the hospital is a better protection of availability, confidentiality and integrity of patient data because of GDPR.

References:

[1]Karen Taylor (2018), "By 2020 the Smart Hospital will be a reality", June 13th, 2017, http://www.futurehealthindex.com, download:March 12th.
[2]Pentty Sydanmaanlakka (2002), "An intelligent organization – integrating performance, competence and knowledge management", Capstone Publishing limited (a Wiley Company).
[3]Archer Software (2018), "Smart Hospital – What is it and how to build your own solution?", http://www.archer-soft.com/en/blog/; download:September 19th.
[4]Strateški plan Ministarstva Zdravstva 2019-2021 (2018), https://zdravlje.gov.hr/UserDocsImages/2018%20Savjetovanje%20sa%20zainteresiranom%20javno%C5%A1%C4%87u/Strateski%20plan%202019.-2021..pdf; download:July 17th.