HIMSS Europe

Experiences and Metrics
for Calculating Return on Investment

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Introduction

Cost, value, return, in short, measurement. It is impossible to consider carrying out any business-related activity or service properly if these concepts are not on the decision-making agenda. Being able to measure the value generated, to plan the environment in which the multiplier effect of an investment's value will be of the greatest benefit to users, and to achieve the maximum return on investment within its economic dimension, has been the objective of health managers and decision-makers for years.

There is a need to assess the impact of the economic situation on health care. The environment of stable or growing demand contains factors that put pressure on expense reduction. These factors make it necessary to go beyond the obvious and to search for the perfect solution to increase efficiency, with innovative proposals and brave management decisions.

In addition, in health care systems, cost reduction, improvement of processes and innovation or the implementation of information and communication technologies (ICT) are a much higher priority than maintaining an equilibrium in the balance sheet or reorganization. For decades, health care economists, health care IT personnel, planners, and clinical and nursing directors have made strides in the establishment of the concept of "health care outcomes", in which improvement in economic indicators is also to the advantage of patients, through a more personalized care, avoiding unnecessary actions, or improved information in the hands of professionals and the patients themselves.

Without a doubt one of the most prevalent ideas in this environment is that the massive deployment of information and communication technologies in the health care field leads to cost savings, improves patient safety and integrates care levels. Even though it is practically a dogma, the idea itself is not enough: the managers and decision-makers need to measure it, and the allocation of resources is now more of a strategic task than ever.

This is why ROI (Return On Investment) in its more orthodox economic dimension, or when it is associated with improvements in satisfaction and patient procedures, is a constant in all informal or academic discussions about how to maintain the quality standards for which Spanish health care is globally renowned.

The attention to costs and the calculation of these is a regular accompaniment of ICT investments in health care

$$ROI = \frac{(Gain\ from\ investment - Cost\ of\ investment)}{Cost\ of\ investment}$$

institutions. However, the monitoring, measuring and verification of the suitability of these projects over time, once introduced, is not common practice.

At HIMSS Europe, in collaboration with Intel, we have formed a group of CIOs (Chief Information Officers) to carry out an exercise that can give value to the ICTs (Information and Communication Technologies), which are currently set up in health organizations, as well as implementation plans throughout the continent.

What tools does a CIO have in order to prioritize their investment projects? How do you convince management that the ICT path leads to cost reduction in health organizations? How do you measure increases in patient safety as provided by a comprehensive and integrated Electronic Medical Record? Are there objective reasons for giving preference to ICT investments over hospital equipment? These and other questions arise in the day-to-day of health organizations as an element of discussion, prioritization and dispute about resource allocation.

Purpose of the document

Therefore, it is necessary to measure with the utmost rigor, keeping in mind the difficulty of quantifying some of the results, and that it may not always be possible to establish a one-to-one relationship between an action and its result, especially in very complex organizational ecosystems such as hospitals.

Such complexity means that the deployment of technology alone will not be able to improve processes or results. In addition, the results obtained have a multi-factorial origin. They require people, processes and systems and it is not always possible to determine the specific weight of each.

An objective or business need to cover cost savings, health care quality and safety improvements, and process efficiency improvements, etc., will require people and processes to be defined and organized, as well as the Information Systems (ICT), in order for them to jointly respond to this objective or need, providing added value to the organization.

The market proposes technological solutions for 99% of the problems but it is important to remember that people and processes are the key factor in these projects: the technology is merely a means.

The purpose of the document is, therefore, to present interesting cases, which have been summarized but have an appropriate level of understanding, without sacrificing the complexity of the ideas, or the stringency of the conclusions. These cases should generate within the ICT health care community an interest in measuring and advancing results in project planning.

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Automation of administrative processes and work in real time

Most hospitals have already computerized the basic administrative processes, such as patient admission, centralized appointments, discharge or registration of the medical episode with the relevant codification. This has made it possible to improve certain processes and study the center's activity.

In this section, we deal with situations that include real-time management criteria, and the automation and elimination of administrative tasks. This involves not only the clinical practice but also the management of and relationship with the patient.

- Arranging appointments for future tests when necessary, with the patient present.
- Avoiding lines and administrative delays helps the patient to have a better perception of the health care they receive.

As part of the health care process, when creating the attendance note or discharge report the patient is automatically given, via a computer algorithm, the day and time of the tests. It is possible to change the details at the time if necessary or to simply leave them as they are, and these can be printed on the document. If the patient decides to change them for any reason, they can do so at a later date by any available means, either in person, by phone if there is a call center, by Internet or at specific service terminals.

If subsequent appointments are processed at the patient's home we will gain a number of benefits, not only of an economic nature, which have been seen and demonstrated in the IDC (Iberia de Diagnóstico y Cirugía) health centers:

- Saving of administrative staff for appointment-making or information tasks, being able to appoint these staff to more productive tasks within the health organization. The experience gained is 1 administrative assistant for every 32,000 appointments (assuming that there are 150 appointments per person per day).
- Improvement in patient satisfaction: they only have to go to their health center or hospital to receive health care, rather than having to go through the administrative proceedings.
- It reinforces the clinical act. An instruction such as "check-up in 3 months" is a clinical procedure, but "check-up on September 16 at 11:00" gives far more importance and accuracy, without the need for an additional administrative procedure as carried out by a third party who has to then repeat the identification tasks, understand what needs to be done, for when and the significance thereof.

Calculation of ROI at the Hospital Sur de Alcorcón (Sur de Alcorcón Hospital)

• Total ICT investment project	€17,000
• Administrative hours avoided	1,232
• Approximate cost avoided	€19,000
• Annual corporate maintenance	€ 3,000

ROI = 112%

Contacting the patient when test results arrive

The presence of the patient is not necessary in all health care processes.

Methodology

Defining a results management system means that certain "routine" tasks can be carried out without the need for the patient to be present:

- On-line results. The patient can see their results without having to travel to the clinic.

- In cases where necessary, health care staff can get in contact with the patient when results arrive in order to decide if the face-to-face consultation needs to go ahead, if there is a need to bring it forward or postpone it, maintain or change the treatment, explain the diagnosis or subsequent steps.
- As a more advanced mechanism, remote consultations can be carried out with a specialist: referrals in the center itself, from residences, primary care centers, correctional institutions, etc.

Results

- A decrease in unnecessary face-to-face consultations: This translates into the reduction of waiting lists and greater patient satisfaction by preventing unnecessary travel to the health center or hospital.
- Advanced results review. When these occur and not when the patient comes for a check-up.

Opens up channels of non face-to-face communication with patients: Appointments, administrative proceedings, clinical information.

Gives the patient the necessary tools so that they can carry out certain administrative procedures themselves and also be more involved in managing their own health.

These tools can include making on-line appointments, health archiving, sending appointment reminders via SMS or email.

Contact mechanisms such as the appointment reminder system at the Fundación Jiménez Díaz de Madrid (The Jiménez Díaz Foundation of Madrid), have led to a decrease of 7% in missed first appointments (about 640,000 means the completion of 44,800 more appointments per year with the same resources) and 2% for subsequent appointments (about 270,000 appointments means the completion of 5,400 more appointments a year). More than 1,000,000 text messages are sent from this center each year with receipt confirmation and at a cost of €70,000.

	Initial consultations	Subsequent consultations
Arranged consultations	640,000	270,000
Consultations that have not been missed	44,800	5,400
Average time (minutes)	25	15
Doctor hours not lost	18,666	1,350
Total no. of hours not lost		20,016
Estimated cost of these hours		€706,000

Table I – Impact of the appointment reminder mechanism at the Fundación Jiménez Díaz de Madrid

ROI = 908.5%

It should be taken into consideration that these figures are obtained with a maximum agreed waiting time of 15 days, during which period the probability of attendance is very high. The longer the wait the more the likelihood of nonattendance (oversight, decision to go somewhere else, etc.) and greater the ROI.

Another example is the elimination of the laboratory appointment and management based on demand.

From a screening request made by a physician, a patient has a guidance system and does not need an appointment. Via the same means, the patient goes to the center and, after introducing their health card into the queue management kiosks, a workflow is triggered, which transfers the request data and communicates the patient's presence to the laboratory system. The patient is called via the screens put in place for this purpose.

Advantages:

- Improves the service provided to the patient. There is no need to request an appointment; it manages patients' time.

- Less waiting in line. The patient does not have to get in line; they are called instead.

ROI calculation at the Fundación Jiménez Díaz:

- ICT investment in development and configuration €19,000
- ICT investment HW, PCs, printers, labels, kiosks and monitors €19,400
- Annual platform maintenance €5,000
- Hours avoided of having administrative assistants at reception: 3,600 h
  (3 administrative assistants on weekdays from 7 to 12).
- Approximate cost avoided €57,500
- Waiting time: previously not measurable. Currently, 15 minutes maximum on days with a peak activity of 500 samples.

ROI = 150%

Eliminate manual systems using informed consent biometric signatures

The informed consent process is a doctor-patient procedure which produces a document that serves as proof of the same and which includes both signatures. This document requires a manual signature, collection, archiving and search system to be maintained if necessary.

Its automation is based on a person's handwritten signature as carried out on a touchscreen capture device, although it is necessary to review the legal setting in each case.

The capture device records parameters such as the speed and pressure made during the signing and generates a calligraphic pattern of the signature based on these parameters.

It requires the introduction of devices for signing in all areas where a patient's or physician's signature might be required.

Results

- Economic benefits:
  - In the Hospital Rey Juan Carlos de Móstoles (Rey Juan Carlos de Móstoles Hospital), an investment of 150 devices means an investment recovery time of fewer than 8 months, assuming a daily collection of 500 signatures. Maintaining a manual system would require between 2-3 people/year for collecting, archiving or scanning, indexing, retrieval, etc.
  - Furthermore, it saves on the costs which the physical space and paperwork of a manual consent file would mean.
- It provides increased security to the management system and safe-keeping of the consent material.
- Professional satisfaction: the patient's consent can be traced.

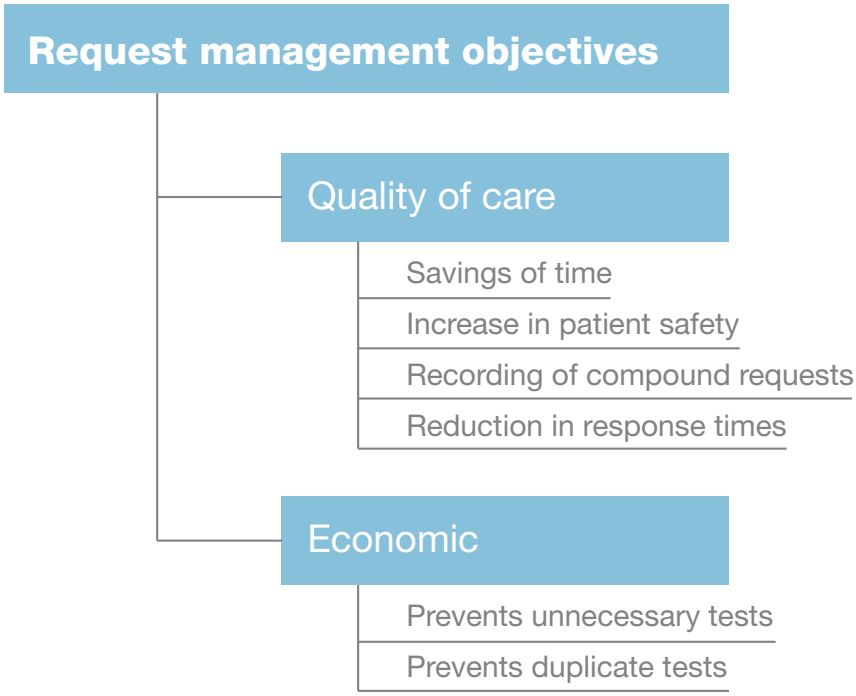
Initial Hardware and Software Investment	€31,750
Annual administrative savings	€60,000

Table II – Biometric signature project at the Hospital Rey Juan Carlos de Móstoles

ROI = 89%

Management of requests: Referrals

Included in the health care procedures that form part of the daily practice of health care personnel are found requests for diagnosis tests, consultations with other specialist clinics, treatment, etc. These are complex processes that combine clinical and administrative tasks, the implementation of an electronic system to replace the paper-based processes and which, among other things, monitors the following results:



Methodology

To measure the profitability of this type of project, it is proposed to compare the estimate of the paper requests management process with the electronic process. For example, in the radiology tests request process we can calculate the time used by each participant in an environment that uses paper and in an electronic environment from the time the doctor makes the request until the test is carried out.

Results

The Hospital Marina Salud de Dénia carefully studied the case of the request for referral to other specialists. Its results include, in table III, an obvious saving of time, which contributes more effectively to the process.

Referrals process								
	Paper	Digital	Worse-case scenario			Best-case scenario		
Task			Participant	Cost	Unit	Participant	Cost	Unit
Carry Out Request								
Include request in H.C.		N/A	Administrative assistant	1	min	Administrative assistant	2	min
Notify the referrals service								
Management of the notification		N/A	Administrative assistant	1	min	Administrative assistant	5	min
Travel of the consultant to the patient's location								
Lending of the H.C. to the consultant		N/A	Administrative assistant	1	min	Administrative assistant	5	min
H.C. Consultation								
Carry Out Referral								
Include referral sheet in the H.C.		N/A	Administrative assistant	1	min	Administrative assistant	2	min
Application of actions recommended by the consultant								
Total				4	min		14	min
No. of referrals per year (2012)				23,767	Referrals		23,767	Referrals
Minutes saved				95,068.00	min		332,738.00	min
Hours/person				1,584.47	hours		5,545.63	hours
Days/person				198.06	days		693.20	days
Months/person				9.90	months		34.66	months
FTE (Full-time employee)				0.83	FTE		2.89	FTE
Paper saved				23,767.00	sheets		23,767.00	sheets

Table III. Estimated savings with the digitization of the referrals process

Not all of the benefits observed in the case studied can be measured, although it does affect positively all of the participants involved in the process and the health organization:

Doctor Petitioner:

- Improves traceability: ensures that the inquiry will be dealt with and records both the inquiry and response.
- Improves the quality of the data: reduces oral transfer of the information, preventing transcription errors and loss of documents.
- Improves times: reduces the response time and application of procedures related to this response. In the case of hospitalized patients the average length of stay is significantly reduced.

Physician Consulted:

- Improves the quality of the data: can standardize the minimum information to be received by the petitioner of the referral (diagnosis orientation, answers to key questions, etc.) by avoiding unnecessary discussion in order to complete the information.
- Improves work organization and the recording of procedure performed.
- Improves the quality of the response by having access to all necessary information.

Patient:

- Improves the quality of care.
- Reinforces patient safety by decreasing the chances of mislaid or missing information.
- Improves response times.

Organization:

- By improving the quality and structure of the data obtained:
  - Opportunity to trace the process.
  - Using the information for measuring purposes and continuous improvement.
- The structured information serves as a support in clinical sessions and training.
- It prevents the physical relocation of the patient's medical history.
- Promotes collaboration and teamwork. The doctor petitioner has complete information about the request and its times and the consultant physician has details of when the request was made.

The following tables reflect the average response times at the Complexo Hospitalario Universitario de A Coruña and at the Hospital Marina Salud de Dénia, obtaining an average response time which implies that virtually all of the referrals are answered in the same time slot or the subsequent one.

The lack of traceability in the old paper-based process prevents us from comparing these results with the times prior to the implementation of the ICT for referrals management. However, we can still say that the process is substantially improved.

Service	Average response time
Endocrinology	14:23:00

Table IV – Average response times of Endocrinology referrals at theComplexo Hospitalario Universitario de A Coruña

Service	Average response time
Allergy Unit	3:23:30
Anesthesia and Recovery	5:18:17
Cardiology	10:05:02
Dermatology	41:46:08
Digestive Medicine	30:31:30
Ear, Nose and Throat	3:37:18
Emergency Physician	0:09:00
Endocrinology	3:26:53
General and Gastrointestinal Surgery	11:57:29
Gynecology and Obstetrics	23:45:29
Health Care Network	0:40:00
Heart Surgery	17:16:30
Hematology	11:27:43
Home Hospital Care Unit	5:40:09
Internal Medicine	28:25:41
Maxillofacial Surgeon	38:53:15
Nephrology	1:28:45
Neurology	16:53:44
Neurosurgery	15:17:00
Occupational Health	10:51:00
Oncology	5:56:00
Ophthalmology	5:33:58
Orthopedic Surgery and Trauma	2:21:18
Pediatrics	9:07:20
Pharmacy	48:12:07
Plastic Surgery	18:18:40
Psychiatry	21:42:57
Pulmonology	14:39:57
Rehabilitation	21:36:20
Resident Anesthetist	8:48:30
Resident Cardiology	3:11:20
Rheumatology	5:15:45
Social Worker	12:45:49
Thoracic Surgery	12:47:00
Urology	19:10:38
Total	**12:23:57**

Table V – Average response times for referrals at the Hospital Marina Salud de Dénia

Digital imaging

Traditionally, the services of radiology and nuclear medicine have been the main driving force behind medical imaging systems in health organizations, but there are many other services and devices that also produce imaging. Therefore, it is important to clarify that when we refer to digital medical imaging we are not just talking about radiological imaging.

Methodology

When an organization considers implementing a digital imaging system, it should take the following factors into account:

- Requirements of the medical services involved.
- Work system:
  - Image analysis.
  - Informed process.
- Technological aspects for integrating with the rest of the organization's systems.
- Economic factor:
  - Investment.
  - Expenditure, including recurring spending for system maintenance.

Table VI shows the distribution of storage for each type at the Clínica Universidad de Navarra.

Type	Matrix	No. Img. exam	Study size (MB)	% study type	% storage type
CT - Computerized tomography	512x512	10 -10000	299.93	28.58	65.11
CR - Computerized radiography	048x2048	1	20.58	22.93	8.29
US - Ultrasounds	640x480		33.15	21.16	9.68
MR - Magnetic resonance	256x256	100 -10000	100.29	12.49	10.31
NM - Nuclear medicine (NM)	128x128	30 - 60	3.82	5	0.24
MG - Digital mammography	4000x5000	4	46	3.38	2.54
PT - PET			100.93	3	2.83
RF - Radio frequency			8.85	1.85	0.61
XA - Angiography			28.65	0.96	0.17
OT - Other			7.84	0.66	0.22

Table VI. Storage by type at the Clínica Universidad de Navarra (University Hospital of Navarra)

Results

With an average of 110,000 studies a year, a historical log of 20 terabytes and an estimated annual growth rate of 8 TB per year and a new medical imaging system, it would place the cost of the study at €1.9 compared with the €8 that an analog chest x-ray can cost.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total	€529,000	€529,000	€137,000	€140,000	€145,000

Table VII. Estimated costs in 5 years (includes storage, software licenses, communications, maintenance, etc.)

Other benefits:

- The architecture and platform of digital imaging allow you to store any other multimedia information that comes from medical devices in standard format (DICOM).
- Improves satisfaction of health care professionals.
- Improves report preparation times, particularly relevant for critical services, such as, for example, the Emergency Department.
- Facilitates universal access to any type of medical imaging.
- Facilitates implementation of second medical opinion systems and sharing of the patient's case report.
- Improves the security of information when establishing access controls through a user/password.
- It can help to improve the billing cycle by reducing the reporting times.
- Reduces patient travel (for example, between primary and specialized care).
- Improves waiting list management, allowing the specialist to screen patients who have to be checked.

Hospital medication process

The hospital medication process, from an exclusively clinical standpoint, is clearly one of the most critical areas of the entire hospital care system, due to the important implications for quality of care and the potentially significant impact on clinical patient safety, which in extreme situations, can pose a risk to the life of these same individuals.

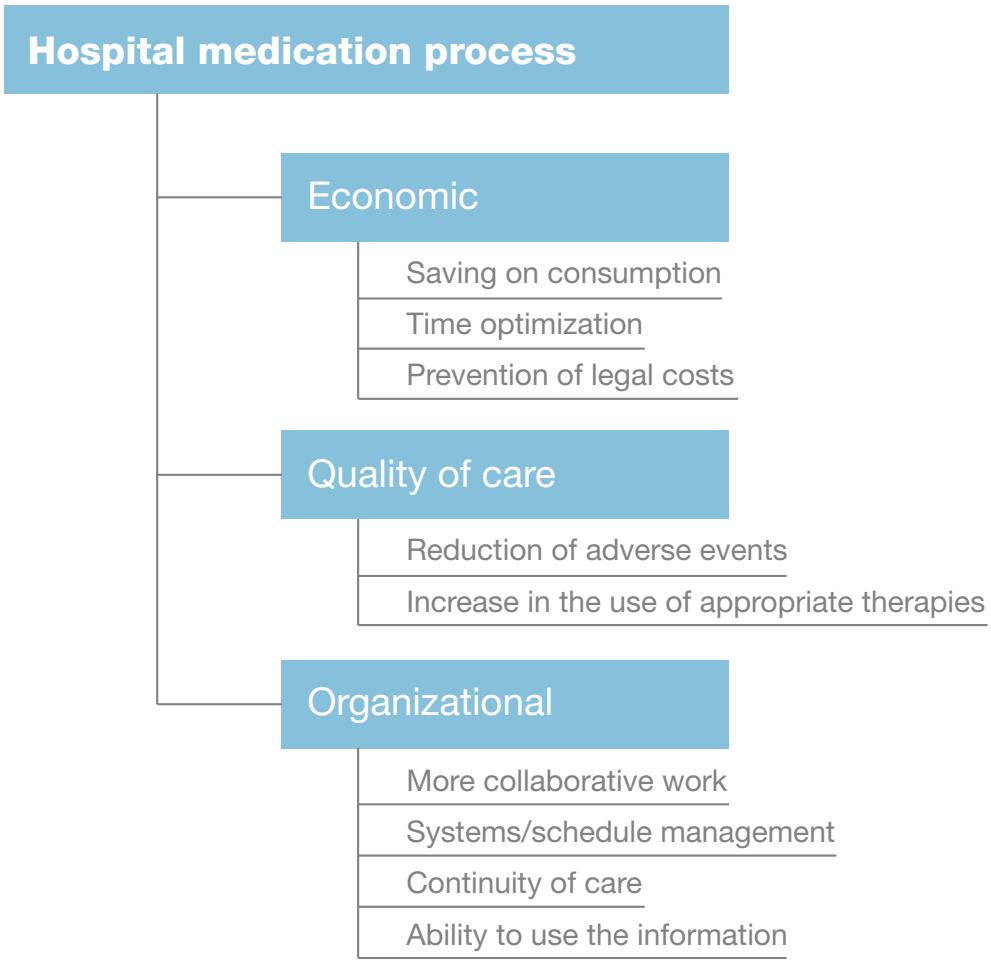
From a purely financial point of view, this is an environment in which high-volume consumption and economic cost are managed, essentially medication, master formularies, parenteral nutrition, etc.

Our proposal relates exclusively to the automation of the medication process, which is shown schematically below:

1 – Hospital medication process workflow

The medication process workflow has a few typical and stringent requirements in terms of data and interactions among professionals, to ensure appropriate communication between them, and effective data exchange in order for them to correctly monitor tasks.

An ICT implementation project in the hospital medication process should include the following objectives:



Results

We will also look at the project's result indicators from three key return areas:

Economic Return:

- Total consumption of medication in hospital.
- Total consumption of medication in hospital per patient.
- % Return/Decrease in medication due to expiration (Cost of returns/Total cost of medication, both in €/year or €/month).
- % Adjustment to medication indication "high cost" or "critical" (No. of prescriptions adjusted to indication/Total no. of prescriptions of medication, in a year or month).
- % Return of medication from factory to pharmacy (No. of prescriptions returned to pharmacy/Total no. of prescriptions, in a year or month).
- Average pharmaceutical write-up time (min/day).
- Average pharmaceutical validation time (min/day).
- Average time for "administrative" nursing tasks (min/day).
- Average time for pharmacy technician preparation and dispensing (min/day).

Clinical returns (quality of care and clinical safety):

- % Adverse prescription events (No. of adverse prescription events/Total no. of prescriptions, in a year or month, total or by medication).
- % Prescriptions based on protocol (No. of prescriptions based on protocol/Total no. of prescriptions, in a year or month, total or by medication).
- % Adverse administration events (No. of adverse administration events/Total no. of prescriptions, in a year or month, total or by medication).

The Hospital Clinic de Barcelona is involved in implementing the hospital medication procedure, having obtained the following results so far:

	Before	After	Savings
Total consumption of medication in hospital			
€ / day of stay	€73	€62	15.7%
€ / patient discharge	€418	€347	16.99%
Total consumption of anti infective medication in hospital			
€ / day of stay	€21	€16	28.57%
€ / patient discharge	€118	€97	17.80%
Generic prescription medication for discharged patients			
% prescription	45%	57%	26.67% (increase)
Medication stock management			
Days in stock	27	19	29.63%

Table VIII – Savings achieved at the Hospital Clinic de Barcelona

This has also led to another type of saving:

- Adding two extra people to the pharmacy department staff to carry out the task of writing up prescriptions was avoided (2 FTE €60-80K/year).
- The time taken for pharmacy technicians to prepare and dispense medication fell by 20% on average (1 FTE, €20-25K/year).
- The time taken for nurses to carry out administrative tasks fell on average by 15% in favor of bedside patient care, due to there being fewer transcription errors and/or interpretation of handwritten notes by the doctors, not having to "hunt down" the doctor in order for him/her to confirm that a treatment should be continued, etc.

We can also find other benefits that cannot be measured:

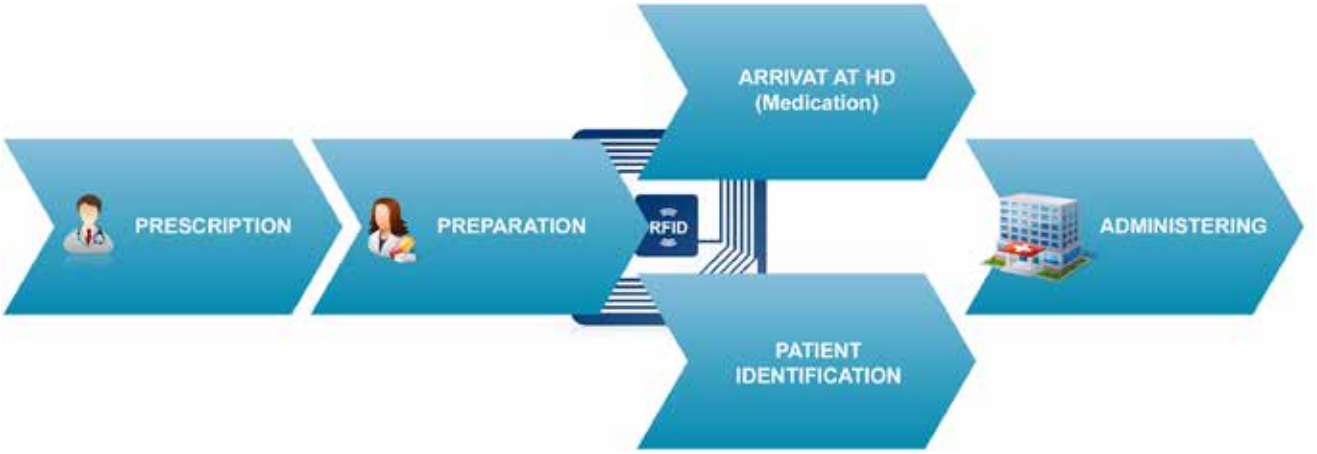
- Legal costs avoided (values based on probability).
- Patient satisfaction.
- Satisfaction of professionals.
- Improves overall efficiency of the collaborative workflow (time reduction, improves communication).
- Improves the quality of information in patients' medical history.
- Complete and guaranteed traceability from prescription to administration.
- Facilitates continuity of care (communication with AP).

Management of complex treatments in the day hospital

All the medications included in the complex treatments category have particular characteristics in terms of the prescription, preparation and/or administration process, such as, for example:

- For serious pathologies: neurological, cardiovascular, musculoskeletal and chronic diseases or cancer, etc.
- They contain active substances that have been recently authorized (within the last 5 years), so they are a priority for the reporting of suspected adverse reactions (RD 1344/2007, or other laws depending on the country).
- Next-generation medication (genetic engineering).
- High treatment cost.
- Orphan drugs.
- Medication for rare diseases.

Therefore, taking into account the characteristics of the medication, those of the patients and the normal operation of the day hospital, an information and alert system is needed, which allows effective, efficient and safe automation of storage, queries and modifications of all the data associated with traceability of the patient and the medication. These are necessary to carry out the medical care process for the patient with the utmost safety, oth in the day hospital and in the health organization's pharmacy service.



2 – Complex medication workflow procedure in the day hospital

Methodology

To implement an automated traceability system for the complex treatment process, wireless localization technologies can be used. The investment for this needs to be recouped as detailed in subsequent sections of the analysis.

The Complexo Hospitalario Universitario de A Coruña installed an RFID + WIFI system for the management of a day hospital with a volume of 1,000 patients/year who receive 6,380 doses. The first-year expenditure in consumables is €44,759.48, which added to the costs for hardware and software infrastructure gives us a total amount, including the cost of the first year, of €99,959.48. Information in detail can be seen in tables IX and X

Infrastructure	€ /u	Units	Total
WIFI Antennas	€300	6	€1,800
Drives	€400	8	€3,200
Proximity card	€300	2	€600
RFID Printer or Software	€2,000 or €2,500	1	€2,500
Software localization	€30,000	1	€30,000
Medication cart + software	€7,900 + €2,000	1	€9,900
Tray medication + software	€7,900 + €2,000	1	€4,500
		Total Infrastructure	€52,500

Table IX. Spending on infrastructure (RFID project for complex treatment management) at The Complexo Hospitalario Universitario de A Coruña

Consumables	€ /u	Units	Total
Medication passive label	€0.336	6,380	€2,143.68
Patient passive label	€0.28	6,380	€1,789.40
Bracelets	€0.13	6,380	€829.40
Active patient tags	40	1,000	€40,000.00
		Total other costs	€44,762.00

Table X. Consumables (RFID project for complex treatments management) at The Complexo Hospitalario Universitario de A Coruña

Results

The traceability system based on wireless technologies provides significant benefits that can be measured using the following indicators, either with an improvement in values or using information that was not available in a manual system.

Patient Traceability Indicators:

- Correct/incorrect identification of the patient.
- Alerting the physician and pharmacy service of the patient's arrival at the day hospital. Recording the time.
- Patient who has left without the medication having been administered.
- Number of medication orders sent by the day hospital to the pharmacy service.

Traceability indicators of the medication:

- Day/time the prescription was received.
- Time of notice of the patient's arrival at the day hospital.
- The time that the medication was prepared by the pharmacy service.
- The time medication leaves the pharmacy service.
- The time medication is delivered to the day hospital.
- Components of the medication (quantity, batch and expiration).
- The time that medication was administered.
- The person who administered the medication.
- Discharge time of the patient.

Cost Indicators:

- Patient who has left without the medication having been administered.
- Medication that expires before being administered to the patient.
- Cost of the unused medication: dose lost or not used.
- Amount of medication returned by the day hospital.

Safety Indicators:

- Misidentification of the patient.
- Patient who has left without the medication having been administered.
- Medication that expires before being administered to the patient.
- Conditions for the prescription and use of the medication.
- Adverse/secondary pharmacological effects: allergy, interaction, intoxication.
- Number of adverse events prevented.
- Batch of the medication.
- Expiration date.

In 2012 the total cost of medication administered in the Hospital de Día del Complexo Hospitalario Universitario de A Coruña, came to €9,724,179.17. Although there is no definitive data at the time of writing this document, it is estimated that the implementation of the system will mean a saving of 15% (€1,458,626.88) of the medication administered in the day hospital.

ROI = 1,399%

Other benefits obtained:

- A decline in additional dose preparation.
- An improvement in stock management.
- An increase in service quality through the decrease in orders.
- Significant improvements in the quality and efficiency of patient care and service through automation of processes and, therefore, a decrease in the number of human errors as a result of the development of these processes.
- Contributes to sustainability due to increased efficiency of the processes, reducing the number of unused doses.
- An increase in staff satisfaction through the implementation of improvement actions throughout the process prescription-validation-preparation/dosage-dispensing-administering of medication to patients in the day hospital.
- An increase in patient safety during the prescription-preparation-dispensing and administering process. And, therefore, a reduction in the occurrence of adverse events:
  - ☐ An improvement in the traceability of the medicines administered (batch and expiration date).
  - ☐ An improvement in patient identification, medication and patient/prescribed medication matching.
  - ☐ Availability in real time and in a unique information label relevant to the patient's safety: the patient's clinical data, composition, time of preparation, pharmacist responsible, delivery time, who it was prepared by, stability, special conditions of use, previous medication, infusion rate, etc.

Nursing care management

The nursing care management process, from an exclusively clinical standpoint, is clearly one of the areas in the hospital care process with the heaviest workloads and volumes of documentation. This has important implications for the quality of care and well-being of patients during their stay in hospital, as well as for their clinical safety.

From a financial point of view, in terms of human resources, this is the largest area of expenditure for a hospital, and its planning and control are extremely complicated, due to the high volume and the necessity of managing teams in 24x7x365 shifts.

Our proposal relates exclusively to the automation of the nursing treatment management process, which is shown schematically below:

3 – Nursing care process workflow

This process is a method that has been implemented with the use of critical thinking (reasoning) and seeks the attainment of specific objectives (expected results) based on scientific principles and the scientific method. Therefore, it is a system that provides the mechanism through which the health care professional can use his/her opinions, knowledge and skills to identify, diagnose and manage the response to actual problems, potential problems or any health-related situations presented by the patient. It constitutes a patient oriented plan to be used throughout his/her stay in hospital.

The nursing treatment management process workflow has a few typical and stringent requirements in terms of data and interactions among professionals, to ensure appropriate communication between them (doctor, nurse and other health care professionals), and effective data exchange in order for them to correctly monitor tasks.

An ICT implementation project in the nursing department should seek the following objectives:

Results

In any case, it is of utmost importance to have previous measurements available of all of the indicators proposed in this document, before introducing any kind of information system and making changes to the work process, in order to be able to measure "a posteriori" the improvements achieved, and confirm the actual return obtained as a result of these improvements.

We will also look at the project's result indicators from three key return areas:

Economic return:

- Average time spent by nurses on "administrative" tasks.
- Average time spent by nurses on patient care tasks.
- Average time spent by nurses on patient assessment.
- % Average time spent by nurses on patient care tasks.
- % Profitability of complementary "structural" teams – substitutions.
- % Adjustment of the average time that nurses spend caring for the patient, to the intensity of the treatment required.

Clinical returns (quality of care and clinical safety):

- % Care plans based on protocol.
- Indicators.
- % Adverse events of care plans.

Non-quantifiable results:

- Legal costs avoided (value could be calculated based on probability).
- Patient satisfaction.
- Satisfaction of professionals.
- Quantification of the cost of care (€, allows subsequent management and cost optimization).
- Improves the overall efficiency of the collaborative workflow (reduced times, improved communication).
- Improves communication between professionals (written record, relevance, acumen).
- Improves the quality of information in patients' medical history.
- Facilitates "continuity" of care (communication with AP).
- Facilitates research activities (for continuous improvement).

Improves surgical planning

Surgical activity plays a very important role within the health care ecosystem. Many activities derive from this, and its decisive nature means that it is a care function of the highest order, which creates significant demand. Therefore, control and supervision of the surgery waiting lists and performance of the operating theaters are key components in the management of the health organization.

Surgery is one of the areas that generates the most costs in hospitals; we are talking about between 10% and 15% of the budget. Because of this, and the increase in the demand for care, there is no doubt that it is necessary to manage the surgical area effectively and achieve a better management of its resources.

We found studies that claim that the optimal rate of occupation of an operating theater should be around 85%, and that each 1% below this percentage represents a cost of between €7,500 and €12,000 per year, per operating theater.

Therefore, the inactivity of the surgical area recorded by hospitals in many cases approximates 30%, which is both a great financial and social cost. For this reason it is essential to know the actual times that the operating theater is in use as well as its shortcomings in order to ensure an effective management that improves the performance of this area.

Methodology

Considering optimizing the efficiency of the surgical area, and while corporate systems continue to be developed, the implementation of a computing tool was proposed at the Hospital Regional Universitario Carlos Haya de Málaga to make it easier for clinical staff to properly allocate times and sessions between the services. This system, which improves the operating theater programming process and helps to generate procedures with standardized criteria to prevent delays, losses of time and avoidable deprogramming, has been in place in the hospital since 2009.

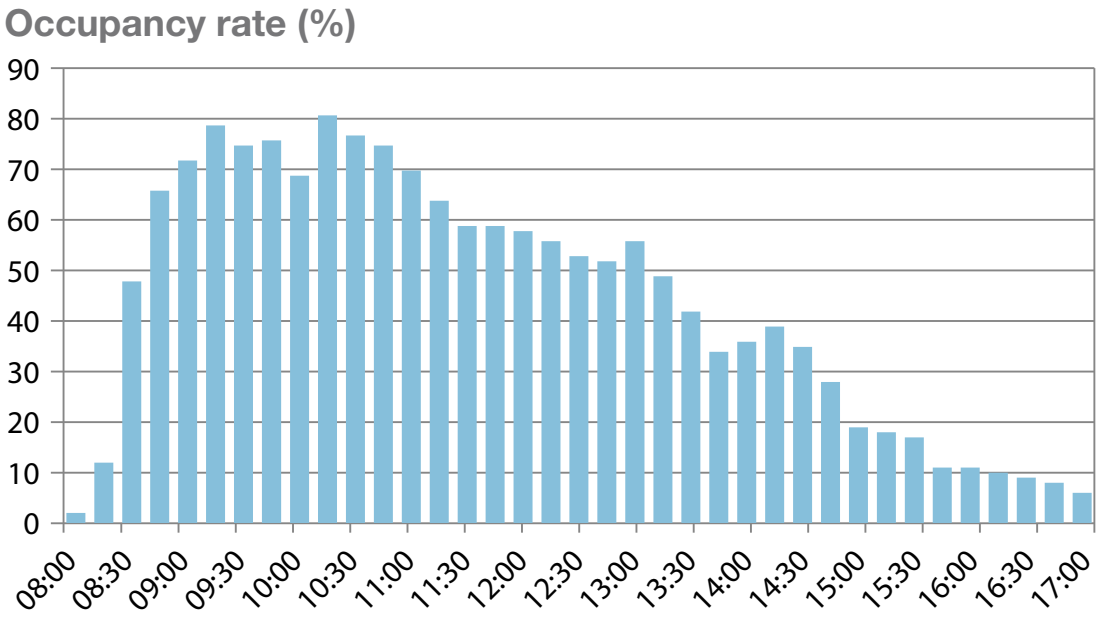


Figure 1. Typical distribution of the occupancy rate for operating theaters per hour

In figure 1 we can see a typical distribution of surgical performance by hour. From 11:15 hours onwards there is a gradual decline in the occupancy rate of the operating theaters, in which the use of the system had a greater impact.

Results

In figure 2 improvements are shown in the performance of operating theaters between the introduction of the tool in 2009 and 2012.

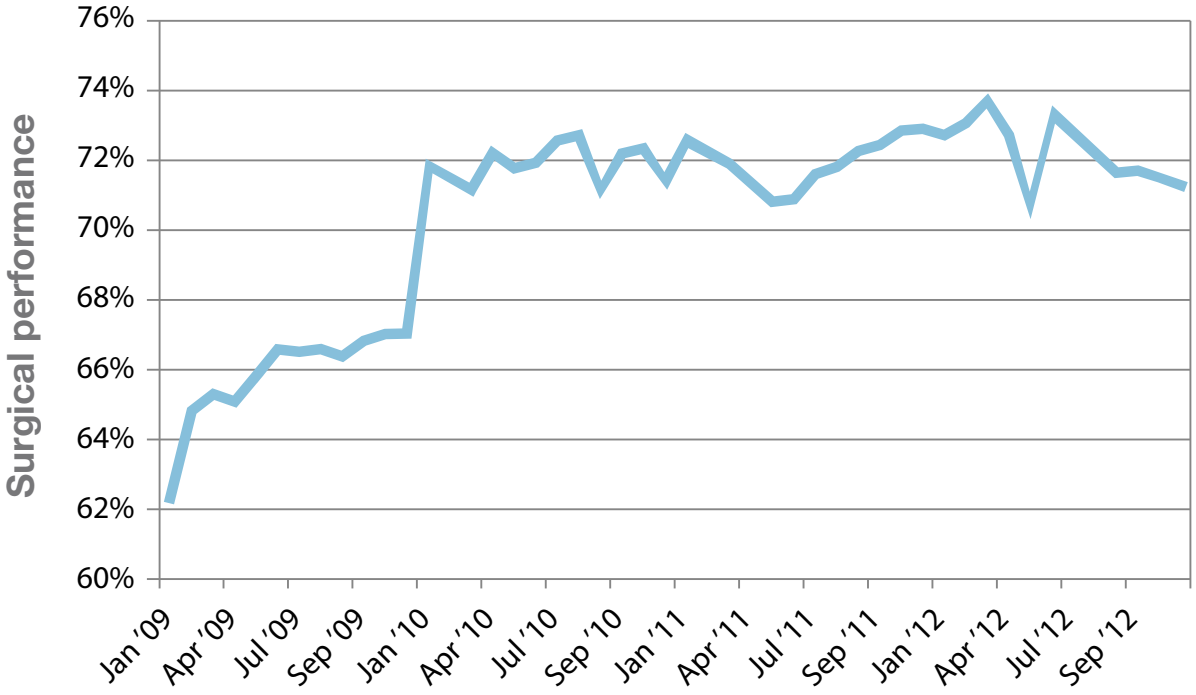


Figure 2. Improvements in surgical performance since introduction of the system

These performance improvements bring with them significant financial savings, obtaining a high return on investment in the first year after introduction of the system.

To perform this calculation the data on spending and saving is divided into two, tables XI and XII.

Description of expense	Amount
Staff (software development, working groups, support)	€75,000
Clinical staff training	€28,500
Software licenses	€6,500
Hardware (PCs, washable keyboards and mice, ...)	€216,000
Other materials (carts for PC support in operating theaters, ...)	€47,500
Total	€373,500

Table XI. System implementation costs

Savings	Amount
Improved performance of operating theaters first year (+5.87% for 38 operating theaters)	€2,689,893

Table XII. Savings in the first year

ROI = 617%

The numbers speak for themselves: the ROI obtained during the first year of implementation at the Hospital Regional Universitario Carlos Haya is very high; however, other benefits that may not be as easy to quantify should also be noted:

- Reduction of waiting lists:
  - Improves health care system user accessibility.
  - Improves patient satisfaction.
- Improves patient safety.
- Higher quality of data:
  - Improves quality and continuity of care.
  - Has a positive impact on the management of the health organization.

Finally, it is important to highlight in particular the way in which the World Health Organization's surgical checklist has been computerized, converting it into a useful tool which is very easy to manage inside the operating theaters. The designed solution has been integrated with the Hospital Information System (HIS) to receive patient and procedure data from this, and to send the results of the checklist to the Electronic Medical Record. Such computerization also prevents the required items from being affected as a result of some type of error or simply due to an oversight, and it is possible to have an automatic record of who the confirmation was carried out by and when.

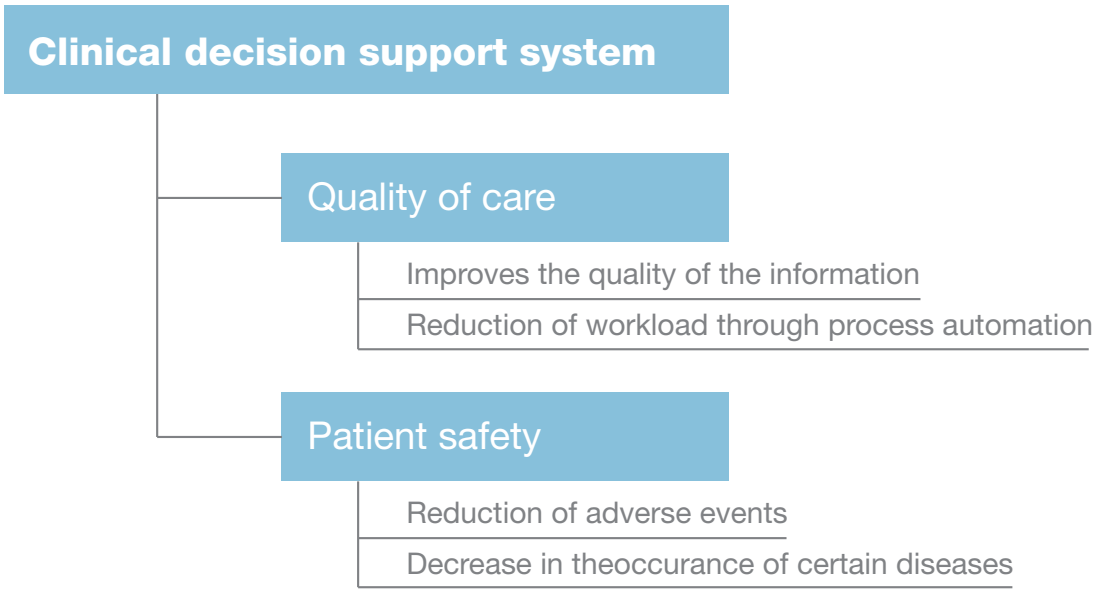
The literature consulted on similar implementations show some spectacular results. In particular, the centers where the results are compared before establishing the surgical checklist and after its introduction, confirm the usefulness of the surgical checklists as the number of complications from surgery fell from 27.3% to 16.7%, and the mortality rate declined from 1.5% to 0.8%. They also show that in the majority of cases, the responsibility usually lies with the entire team (surgeon, nurse and anesthetist), and that, had there been a checklist, the majority of these errors would not have occurred.

Clinical decision support systems

A health organization's information systems are large repositories of unstructured data among which there are reports, diagnostic imaging or laboratory results, allergy information, etc. A clinical decision support systems should ensure that the Electronic Health Record (EHR) evolves from being a passive tool to become a proactive tool for health professionals and that it automatically analyzes in real time the newly generated data from any information source.

The clinical decision support systems should bring a patient's condition to the attention of head clinicians through the most appropriate means in each case (EHR, caregiver, e-mail, 'phone,...), as well as the recommended actions. There is no closed set of support systems projects for clinical decision-making: almost any process is capable of working with a decision-making support system.

It is necessary to keep in mind, among other aspects, the following objectives.



The case of clinical alerts at the Complexo Hospitalario Universitario de A Coruña

The overall economic assessment of a project like this is complicated and can only be done by comparison with periods prior to introduction of the system. This is due to the fact that a change is being made from a general service provision model: i.e., the move from a reactive to a proactive model, and this will be a slow transition, which requires all of the professionals to adapt to this new model.

However, partial assessments can be made, which are much more objective for any one of the strategic objectives, primarily with regard to the automation of routine tasks:

Automation of gynecological pap smear results:

For best results, it is necessary for the Anatomical Pathology Service to use a coding system, SNOMED CT. This ensures that the automatic assessment of results is always effective.

Objectives

- To prevent results review by the petitioner.
- To avoid unnecessary inquiries of results review.

Results

For the time being, at the Complexo Hospitalario Universitario de A Coruña, it is the specialist who decides if appointments are made for reviews of non-pathological results. In table XII we can see what the savings would be if none of these consultations took place.

	Pathological	Non Pathological	Total	
Number of tests	12,783	14,348	27,131	
Minutes (10 min / consultation)		143.480 min	271.310 min	Saving of 53%
Hours		2,391 H		
Specialist		1.45 gynecological/year		

Table XIII. Savings in pap smears based on 2012 data at the Complexo Hospitalario Universitario de A Coruña

Other benefits obtained with this project include:

- Substantial improvement in the handling of positive results.
- Improvements in the waiting list.
- Improvement in patient satisfaction.
  - ☐ Decreased anxiety about results/reviews.
  - ☐ Reduced travel expenses to the surgery.
  - ☐ No loss of work hours in order to attend unnecessary consultations.

Other examples that already work are dermatological biopsies. Within this service it was decided to communicate negative results by telephone, which has meant the disappearance of all reviews for non pathological results, thereby significantly improving the waiting list by the amount of consultation review time that is freed up for the specialists.

The case of prevention of thromboembolism at the Clínica Universidad de Navarra

The aim is to identify those patients admitted who have a significant risk of developing venous thromboembolism (VTE) so that the appropriate measures are taken at the medical and nursing care levels. In addition, it allows the monitoring of prophylactic measures carried out on patients, depending on the degree of calculated risk.

According to a study conducted by specialists from the Clínica Universidad de Navarra, the introduction of a computerized alert system to prevent the occurrence of venous thromboembolism in all Spanish hospitals would mean an annual saving of nearly 30 million euros, by avoiding the costs derived from this disease.

The direct costs of venous thromboembolism were reduced from 21.6 euros to 11.8 euros per hospitalized patient, compared to the costs generated by the increase in prophylaxis and in the establishment and maintenance of the alerts, which were 3 euros and 0.35 euros per patient, respectively. Therefore, the savings for each hospitalized patient is 6.5 euros.

The risk of a patient suffering from venous thromboembolism depends on several factors: some relate to the patient himself/herself and others depend on the situation in which the patient finds himself/herself. The type of information that is collected includes:

- The surgical procedures carried out on the patient on admission, which pose a high risk of causing VTE later on.
- Other surgical procedures performed on the patient during admission. The determining factor in this case is the duration of the procedure and the patient's age.
- Personal history and the reason for the patient's admission: i.e., the predisposition that the patient may have for developing venous thromboembolism.
- Another factor involved is the patient's age; if the patient is not admitted for surgical reasons.
- Certain medication administered to the patient can increase the risk.
- If, during admission, a portacath has been placed in the patient, via central or Hickman line, the risk increases.
- The risk is higher in obese patients (BMI>30).
- The risk increases while the patient is in absolute rest.

All of the above factors are involved in the calculation of the risk of suffering from a thromboembolism. All of this data is collected from the various information system modules: nursing care, doctor's orders, nursing record of vital signs and procedures carried out.

The case of the Sepsis clinical pathway at the Hospital Marina Salud de Dénia

Fourteen Spanish scientific companies signed the Declaration of Majorca in November 2012 to promote the creation of Code Sepsis, both at the local level as well as at the institutional level supported by national health authorities and the different Autonomous Communities. The aim of "Code Sepsis" is the early detection of patients with severe Sepsis (in the different levels of care), the structured application of the set of recommended measures in order to diagnose, monitor and treat these patients, and the definition of a few care indicators for assessing compliance with the recommendations and the results of the application of the code at the local and national level.

The optimization of Sepsis management is associated with a reduction in health care costs, which are currently quantified at around €17,000 per case.

Methodology

The Sepsis protocol is based on the following key points:

1. The Sepsis Rule: "A continuous and ongoing radar or guard" of the data stored in the patient's EHR, which will alert us when a patient meets the predefined Sepsis criteria, and whose function is the early detection of Sepsis.

2. A clinical pathway of "Severe Sepsis and Septic Shock, first 6 hours," which constitutes a reminder system that displays a diagnostic and therapeutic roadmap, activating the Sepsis team and collecting in a standardized manner the diagnostic and therapeutic measures to be carried out in the first 6 hours, associated with decreased mortality, and ranging from the parameters to be monitored, relevant parameters for the microbiological diagnosis and source control, the optimal empirical antibiotic treatment for each clinical situation and hemodynamic resuscitation. All of this, as support for the physician, without limiting the modifications that they may want to make according to their best judgment.

Objectives

- To reduce the number of cases of Sepsis per year in each of the 3 stages (septic shock, Sepsis and severe Sepsis).

The casuistry study was started in 2013, with the aim of carrying out a comparative study between the financial years 2009-2013. At the Hospital de Dénia, in the period from April 25 to June 7, the following results were obtained:

Cases in which the alert was activated	207
Cases with preliminary assessment of Sepsis recorded by the physician on the form	49
Septic shock	5
Sepsis	22
Severe Sepsis	22
Cases confirmed by the physician by including a diagnosis of Sepsis when the patient is discharged	28
785.52 Septic shock	2
995.91 Sepsis	10
995.92 Severe Sepsis	16
Total	28
Number of cases in which "Sepsis Team" was activated	18

Table XIIV – Data from digital Code Sepsis at the Hospital Marina Salud de Dénia

There will be savings as a result of the decline in cases of shock and Sepsis due to early intervention.

Non face-to-face services

When we talk about non face-to-face services we refer to those services which due to ICT help improve care services or the clinical coordination between professionals and/or patients such as telemedicine, telecare or collaborative work platforms. These projects are made possible as a result of ICT and enable the transformation of clinical processes, system restructuring and the connection of professionals and hospitals with other health centers in remote locations.

Asynchronous Telemedicine

For years asynchronous and synchronous telemedicine has been used for different processes and specialties. In several specialties it has been confirmed that asynchronous telemedicine projects produce the following results:

- Elimination of unnecessary travel of the patient to the hospital.
- Reduction in the diagnosis time in cases of low and medium complexity.
- Sharing of knowledge between specialists and family physicians.
- Provides the opportunity to work with experts from outside the organization.
- Acceptance on a large scale of the technological solution by physicians and specialists.
- Reduction in waiting lists to see a medical specialist.
- Prevents duplication of diagnostic tests.

However, it has always cost a lot to set up the telemedicine process as a more accepted system within the health organization. While the technology is ready and validated, it involves a change in the process and in the coordination of care that affects different clinical units both inside and outside the hospital. However, technology advances and it allows you to take another step forward, not only by facilitating the exchange of images but also by processing these images.

For example, the development of a software system for the automatic screening of diabetic retinopathy images enables early detection of the disease in the diabetic population. Automatic processing is shown to be a reliable means of obtaining a first level diagnosis without requiring specialist intervention.

Diabetes is the second cause of blindness in Spain and the primary cause of total loss of vision in the working age population. It is estimated that between 15% and 30% of people with diabetes suffer from diabetic retinopathy. The best protection against the progression of this disease, in addition to controlling diabetes, is the early detection of the retinopathy through periodic checks in which Fundus photography is carried out in both eyes of chronic patients.

After the taking of images, each Fundus photograph should be checked an average of two times by qualified specialists, through a slow process, which is tedious and expensive, with the aim of issuing an accurate diagnosis.

Today there are non face-to-face capture, transmission and imaging analysis systems.

The images obtained by the Fundus photographs are sent securely to a centralized repository (the cloud), from where an automatic screening algorithm (also in the cloud) evaluates and detects the presence or absence of retinal lesions. Ophthalmologists can consult the screening results directly, being able to filter those patients with lesions for a subsequent examination and the issuing of a new diagnosis.

Trials with the following results have been carried out:

- 15,000 patients examined in one year.
- 20% diagnosed with diabetic retinopathy.
- 95% sensitivity and specificity of 70%.
- The workload of doctors was reduced by 45% and it allows the specialist to focus on the patients' pathologies.

In addition, other forms of telemedicine whose main objective is to facilitate collaboration between the primary care center and the specialist observed the following benefits:

- Elimination of unnecessary travel of the patient to the hospital.
- Reduction in the diagnosis time in cases of low and medium complexity.
- Sharing of knowledge between specialists and family physicians.
- Creation of web knowledge repositories.
- Provides the opportunity to work with experts from outside the organization.
- Acceptance on a large scale of the technological solution by physicians and specialists.
- Reduction in waiting lists to see a medical specialist.
- Prevents duplication of diagnostic tests.

2012		2013 (up to 06/22)	
Service	No. of remote consultations	Service	No. of remote consultations
Dermatology	3,245	Dermatology	1,535
Ophthalmology	867	Ophthalmology	523
		Angiology and Vascular Surgery	68
		Endocrinology	38

Table XV – Telemedicine at the Complexo Hospitalario Universitario de A Coruña

Health 2.0: Collaborative environments

Social networks, collaborative tools and web 2.0 have led to a revolution in the formation of new virtual communities that communicate, share and collaborate on a global and universal basis. They share photos, personal comments, messages and professional information. Anyone can have an online profile on any of the referenced sites (LinkedIn, Facebook, Twitter, etc.).

In health care, the use of this type of tool creates new and interesting scenarios where the sharing and collaboration of knowledge can help foster the obtaining of a faster and more accurate diagnosis as well as to connect patients with patients, doctors with doctors and doctors with patients.

There are many initiatives for the use of specific or standard tools for Health 2.0 projects. Many are dangerous, old or disruptive. Some are consolidating and allow the traditional forms of clinical collaboration to be changed. We refer to projects that enable collaboration between clinical professionals for the discussion and sharing of clinical cases where the risk to privacy is minimal (anonymous clinical case) and the resulting care is improved thanks to the collaborative care. Projects that provide a second medical opinion by specialists located remotely; collaboration with less developed countries (Spain-Africa); knowledge sharing for medical training; access to specialists in any part of the world or virtual tumor committees.

It allows you to organize virtual tumor committees with professionals from different hospitals.

The workflow is based on the creation and sharing of clinical cases that are presented at tumor committee meetings. This case is shared privately among a group of professionals to encourage the multidisciplinary approach. It generates a discussion through comments on the clinical case in order to make decisions about the treatment, diagnosis or monitoring of the same.

After the survey was conducted on the relevant users, it was concluded:

That the three basic reasons for accepting and using a professional collaborative platform are:

- Rapid decision-making, prediction of decisions and preparation of cases.
- Inclusion of all the clinical elements necessary for diagnosis (case summary, images, documents, reports).
- When the binding decision, made in the tumor committee, is recorded, that its implementation is promoted in practice.
- The possibility of developing non face-to-face committees, help in decision-making and encouraging participation between hospitals.

Benefits observed:

- Facilitates homogeneity in the information for presentation of clinical cases.
- Compacts the relevant information on clinical cases, which centers the decision-making process firmly within the Tumors Committee.
- Predicts and documents the opinions of different specialties/specialists involved in the Tumor Committee.
- Standardizes communication between hospitals that refer clinical cases.
- Records the cases treated in the Tumor Committees as an important source of teaching and research material.
- Improves the quality of health care given to the patient: multidisciplinary approach.
- User (clinical) assessment is very positive.
- Prevents repetition of complementary tests in patients coming from other services or hospitals.
- Helps to reduce waiting times. Additional guidance on early treatment by sharing the same information from a patient in real time.

- Facilitates the selection of patients for inclusion in clinical trials (cost savings for the hospital).
- Enhances and promotes collaboration within the industry: powerful tool with which to promote clinical research in the hospital.
- Improves system management. Facilitates the Tumor Committee's self management.
- Supports the dissemination of publications.
- Standardization of clinical practice in new procedures such as IORT (intraoperative radiation therapy).
- Teaching: Repository of medical knowledge that is used in the training of medical students and residents.

Some centers are rethinking the workings of the committees both inside the hospital and at the Autonomous Community level. The reorganizing of health care services can even be contemplated through a concentration of specialized key services (oncology, dermatology, ophthalmology).

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