

## Background

- Logistics, in the healthcare sector, could help in order to promote the quality of services and to encourage the sustainability, especially from an economic perspective
- Automation of hospitals medication management, thanks to multiple innovative technologies that are emerged, demonstrated advantages towards manual systems, to overcome the critical issues of traditional logistics and manual dispensing systems
- The advantages achievable have a double nature: automation brings managerial benefits (i.e. complete traceability of drugs, control of the stock, reduction of expired drugs), but also clinical benefits (i.e. error reduction, better patient safety)
- Despite literature on benefits exists, no multidimensional evidence on automation of hospital medication management is available. In addition, all the stakeholders (pharmacists, nurses, clinicians, decision makers, biomedical engineers or IT Specialists) have different perceptions and experiences concerning technologies

## Aim and Objectives

- The study would demonstrate the value of three different scenarios in which automated technologies are implemented with different levels of integration in comparison with a scenario in which the drug dispensing process is performed in a manual way (scenario 1). The four comparative scenarios are:

- manual dispensing, both in the Hospital Pharmacy and in the wards
- presence of automated dispensing systems only at the Centralized Level in the Hospital Pharmacy
- presence of automated dispensing systems in the Wards
- integration of Scenario 2 and 3 into a full solution, with electronic prescription

Scenario	Manual (or traditional dispensing)	Pharmacy Based ADD*	Ward Based ADD	Pharmacy Based ADD + Ward Based ADD*
Scenario 1	X	X		
Scenario 2		V	X	
Scenario 3		X	V	
Scenario 4		V	V	

- An approach based on the Health Technology Assessment generates multidimensional evidence. Efficacy, safety, equity of access, social and ethical aspects, organizational impact and economic impact are studied to have an **integration of these multidimensional perspectives with literature evidence**

## Materials and Methods

After a structured literature review, the 9 Domains of EuneHTA Core Model were deployed using validated questionnaires (with 7 item-Likert scale)

Differences among groups and scenarios were studied using ANOVA test. All analyses were conducted considering a level of significance equal to 0.05 and were performed with the assistance of the IBM® SPSS® software (version 22.0)

The economic assessment was performed using: Activity-Based Costing analysis, Cost-Effectiveness Analysis and Budget Impact Analysis

## References

- Ahtiainen et al. Safety, time and cost evaluation of automated and semi-automated drug distribution systems in hospitals: a systematic review. Eur J Hosp Pharm 2019; 0: 1–10
- Berdot et al. Return on Investment after Implementation of a Centralized Automated Storage System in a Hospital Pharmacy. 2016; 4: 526-532
- Franklin et al. An evaluation of two automated dispensing machines in UK hospital pharmacy. 2008; 16(1): 47-53

## The sample

The HTA involved **129 healthcare professionals** (pharmacists, nurses, decision makers and other professionals), in **6 European Countries** (Belgium, France, Germany, Italy, Netherlands, United Kingdom) in 2021

Professionals are divided by their professional role and their actual use of automation. In particular, the study involved: 46 pharmacists, 40 nurses, 19 biomedical engineers and IT specialists and 24 decision makers

The professionals were also stratified considering:

- 77 already automation users
- 52 potential automation users

## Efficacy and Safety

Results from efficacy and safety questionnaires showed that the presence of automation resulted in a **decrease in medication administration errors** (-1.14; 0.95; 1.57; 1.89, respectively for Scenario 1,2,3,4, p-value < 0.001) and consequently in **adverse events** (-1.67; 1.23; 1.36; 2.17, respectively for Scenario 1, 2, 3 and 4, p-value < 0.001)

## Equity, social and ethical aspects

Healthcare professionals appreciate **the impact on the patients' clinical pathway efficiency** (-0.71; 0.79; 1.07; 1.43, respectively for Scenario 1, 2, 3 and 4, p-value < 0.001) due to the decrease in errors occurrence rate and **the impact on the trust between healthcare professionals and patients** (-0.17; 0.88; 1.07; 1.25, respectively for Scenario 1, 2, 3 and 4, p-value < 0.001), due to an increase in terms of patient safety

## Legal impact

The most appreciated item was represented by **the impact on drugs thefts from hospital stocks**, especially in the wards (-1.88; 1.52; 2.12; 2.37; respectively for Scenario 1, 2, 3 and 4, with a p-value < 0.001)

## Conclusions

- Safety is the most important and prioritized HTA dimension**, followed by effectiveness, organizational and economic impact. Benefits related to automation were recognized in all domains, but **it is often unclear the incremental benefits of the integrated automated solutions in comparison with the presence of single technologies**. Positive economic impact was registered in case of full automation.
- Organizational impact is positive with a **trade-off in the first year due to internal efforts in the learning curve**. Benefits are overall well recognized with gaps for some categories of healthcare professionals.
- In conclusion, the study underlines the importance of **promoting studies and supporting technology introduction to facilitate the Change Management in all the European hospitals**.

## Contacts

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## Results

### Prioritization

The prioritization is confirmed also stratifying results considering healthcare professionals' role and their actual automation use

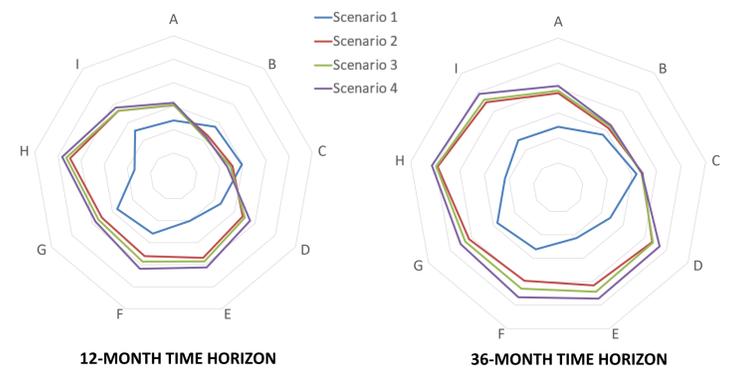
Decision makers considered organizational impact more important than effectiveness

**Already and potential users had the same perceptions**

Dimension	Prioritization
Safety	9
Effectiveness	8
Organizational impact	7
Cost and economic impact	6
General relevance	5
Technical relevance	4
Legal impact	3
Social and ethical impact	2
Equity impact	1

### Organizational impact

- Good impact in terms of **stock management, storage capacity and drugs allocation criteria** (item H: -1.32; 1.47; 1.64; 1.82, respectively for Scenario 1, 2, 3 and 4, in the short run, with a p-value < 0.001)
- Healthcare professionals' organizational well-being and satisfaction, and relationship between professionals** were appreciated items
- The **acceptability of the technology**, according to healthcare professionals' point of view, was influenced by **intention to use, results demonstrability and real-life usefulness**.
- Considering **36-month time horizon**, on average, **the scenarios with the presence of automated systems obtained higher positive results** compared with the 12-month time horizon



Legend: A) Need for additional staff; B) Need for additional training courses and additional hospital meetings needed to promote the proper use of the technology; C) Learning time and curve; D) Technology impact on the healthcare professionals' workflow (nurses, pharmacists, technicians, other professionals); E) Impact of technology on time of the overall drug dispensing process (from the purchase order to the request from wards to the administration to patient); F) Impact of technology on facilitating connection between wards and between Hospital Pharmacy and wards; G) Impact of technology on the relationship between healthcare workers (Pharmacist, Nurse, technician or other); H) Impact of technology on storage capacity, drugs allocation criteria, inventory management and stock out; I) Impact of technology on healthcare professionals' organizational well-being and healthcare professionals' satisfaction

### Economic impact

#### 1. Process Mapping

Based on three determinants of costs: human resources, expired drugs, impact on errors

#### 2. Cost-Effectiveness Analysis

Cost effectiveness parameters is calculated, started from the literature evidence and considering packages movements in the hospital involved in the study

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Italy	6.81 €	3.67 €	6.46 €	<b>3.32 €</b>	7.39	3.94	6.84	<b>3.48</b>
Belgium	11.12 €	6.36 €	10.65 €	<b>5.89 €</b>	12.06	6.84	11.28	<b>6.19</b>
France	9.51 €	5.10 €	8.99 €	<b>4.58 €</b>	10.32	5.49	9.52	<b>4.81</b>
Netherlands	5.22 €	2.87 €	4.97 €	<b>2.61 €</b>	5.66	3.08	5.26	<b>2.75</b>
Germany	7.96 €	4.36 €	7.56 €	<b>3.97 €</b>	8.64	4.70	8.00	<b>4.16</b>
UK	£ 16.79	£ 12.66	£ 15.60	<b>£ 11.47</b>	17.16	12.90	15.78	<b>11.56</b>

#### 3. Budget Impact Analysis

Average Medications per day Central Pharmacy: **1,864**

Average Medications per day Ward: **169**

Medium size hospital (778 beds), with one Hospital Pharmacy and six Dept.

COUNTRY	SAVINGS	
	MIN	MAX
UK	10,000.000 €	562,000.000 €
Others	54,000.000 €	602,000.000 €

Automation had a good impact on budget with a percentage deviation from **0.4% to 26.0%**