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Selection of Key Performance Indicators for an Economic Evaluation of Artificial Intelligence Technologies. The Case of HosmartAI (HORIZON 2020 FUNDED PROGRAM)

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Background

Artificial intelligence (AI) is mentioned as a facilitator for more personalized and safer healthcare services [1]. AI is gradually changing medical practice. Several AI applications were adopted by medicine and used in medical fields, such as clinical, diagnostic, rehabilitative, and predictive practices [2].

The economic evaluation of AI has been addressed only sporadically, although used by policymakers for adopting new technology [3]. Key Performance Indicators (KPIs) have long been utilized as measurable landmarks to evaluate the benefit for patients and society of AI.

HosmartAI project – "Hospital Smart development based on AI" aims to be the most relevant player for the digital transformation of the European healthcare sector, to make the European healthcare system more strong, efficient, sustainable and resilient. HosmartAI will create a common open Integration Platform with the necessary tools to facilitate and measure the benefits of integrating digital technologies (robotics and AI) in the healthcare system [4].

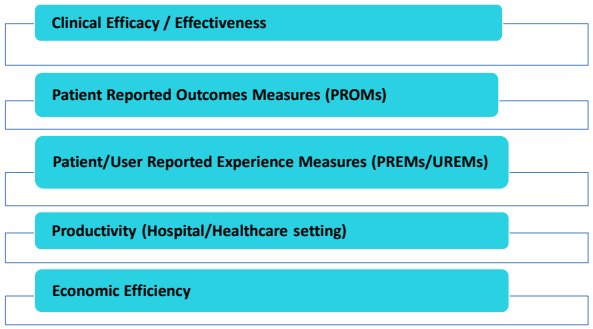
Objective

The study aimed to identify the most important KPIs to perform an economic evaluation of 8 pilots, 11 medical scenarios and 1 administrative scenario.

Methods

- A challenge in the identification of KPIs for HosmartAI, was due to the diversity of technologies involved, requiring a variety of instruments for one or more KPIs for each specific technology on a proof-of-concept basis.
- To enable the full potential of the AI technologies, a comprehensive selection of KPIs were identified, in order to cover the whole spectrum of outcomes and involved stakeholders of the healthcare sector and decision-making bodies. The HosmartAI KPIs pillars is presented in Figure 1.

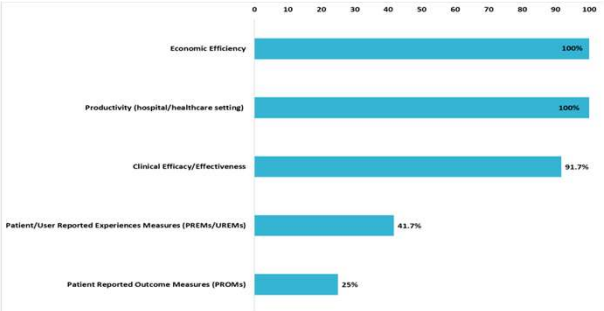
Figure 1. HosmartAI KPI Pillars



Results

- Based on the proposed KPIs, the pilots chose the appropriate ones to assess the economic evaluation of each technology.
- All pilots chosen the following outcomes' metrics: economic efficiency and hospital productivity (100%), as well clinical efficacy/effectiveness (91.7%), since they believed that the new AI technology will be more or similar efficacious to current practice, while reducing the examination time in a more user-friendly way. The rest outcomes were selected by fewer pilots (Figure 2).

Figure 2: Selected outcomes' metrics



Results *(continued)*

- In the HosmartAI project for AI and robotics in hospitals and residential facilities, 8 pilots will test their services against an array of "KPIs" (Table 1 and 2).
- In pillars PROMs and PREMs/UREMs, pilots chose generic instruments such as System Usability Scale (SUS), User Experience Questionnaire (UEQ), EQ - 5D, which represent the most commonly undertaken assessments for new technology.
- The pillar productivity will be measured using number of persons contribute to procedure, duration of procedure in minutes or hour and mean monthly salary.
- Finally, the cost of artificial intelligence technology vs current technology, patients' cost of transportation, income loss, and treatment cost will be composed to evaluate the pillar of economic efficiency.

Table 1. Selection and Evaluation of KPIs of HosmartAI pilots 1 - 4

KPIs	Pilot 1				Pilot 2	Pilot 3	Pilot 4
	Medical scenario 1	Medical scenario 2	Medical scenario 3	Medical scenario 4			
	Echocardiography for assessment of Left Ventricular function	*Capsule Endoscopy for Small Bowel Disorders*	*Coronary Computed Tomography Angiography for Coronary Artery Disease*	*Pregnancy abnormality detection*	*Optimizing the use of radiotherapy*	*Treatment Improvement in rehabilitation process.*	*Robotic systems for minimally invasive operations*
Clinical Efficacy/ Effectiveness	Clinical effectiveness metrics		AI predictive model clinical performance		-	Clinical scales	In vitro: Duration Accuracy
PROMs						EQ - 5D - 5L	
PREMs/ UREMs	SUS	SUS	SUS	SUS	UEQ, SUS	PSQ, UEQ, SUS	SUS
Productivity	Number of participating staff & duration of procedure						
Economic Efficiency	Direct medical / non-medical costs and indirect costs						

Table 2. Selection and Evaluation of KPIs of HosmartAI pilots 5 - 8

KPIs	Pilot 5		Pilot 6	Pilot 7	Pilot 8
	Medical scenario 1	Medical scenario 2			
	Assistive robot care on Grand Rounds and Thoracic surgery patient assistance through robot nurse in hospital	*Effects of interactive digital assistance on patient engagement and perceived QoI of surgery patients and self-efficacy and workload of staff*	*Assistive care in care centre: virtual assistant*	*Smart Cathlab Assistant*	*Prognosis of cancer patients and their response to treatment combining multiomics data*
Clinical Efficacy/ Effectiveness	vital signs, blood pressure, temperature, hydration etc	vital signs, blood pressure, temperature, hydration etc	mini mental, temperature, oxygen, saturation, blood pressure, heart rate etc	coronary angiogram & physiology data -Patient X-ray dosimetry etc	Data collection image & genetic
PROMs	EQ - 5D - 5L		GDS, EQ-5D-5L		
PREMs/ UREMs	VAS, SUS, UTAUT2	UEQ, PHE, PQMC	UEQ, SUS, PSSUQ	SUS	SUS
Productivity	Number of participating staff and duration of procedure				
Economic Efficiency	Direct medical / non-medical costs and indirect costs				

Conclusions

In AI technologies, the choice of KPIs is not straightforward as in other medical technologies/pharmaceuticals. KPIs represent an integral part of AI technologies to monitor effectively and optimize punctually healthcare services, improving patient outcomes and facilitating the reimbursement processes. However, outcomes should encompass both medical and engineering KPIs.

References
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