The need of a health technology assessment perspective in emergency medicine

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When considering the classical definition of health technology as *any drug, device, medical or surgical procedure devoted to disease prevention, diagnosis, treatment or rehabilitation*, one acknowledges how many aspects of *pre*-hospital and emergency care are merged into the technology bundle: from the nasopharyngeal cannula to advanced airway management devices, from O_2 saturimeter to the blood gas analyzer, from the electrocardiograph to ultrasound machines, from the point of care testing devices to complex health information and communication technologies. Unfortunately, the view that new, costly and glamorous health technologies automatically lead to better health outcomes is unsubstantiated and overoptimistic.

Several cases may help show the risks and wastes of injudicious use of technologies, with particular regard to the emergency medicine world, and why a sound perspective on the issue is so important.

The unintended consequences of high-tech medical imaging and the fastest growing medical expenditure have been pointed out clearly: an evidence base often inconsistent, the needless exposure to downstream tests to reduce uncertainty and to (often risky) treatments due to over diagnosis, the so called *shot gun approach* favored by the overweight of small risks and liability for under use much more than for overuse, leading to deliberate defensive medicine strategies. Unfortunately, all these aspects and attitudes are common among emergency physicians. In fact, one of the best cases studied is the increase of computed tomographic (CT) pulmonary angiography for suspected pulmonary embolism, which leads to a substantial over diagnosis of cases of doubtful clinical significance. Similar uncertainties surround the real benefit derived by the increased use of whole body CT in emergency departments for major traumas.

Also medical devices, adopted with approval procedures far more imperfect and permissive than those used for new drugs, are another example of the problematic health technology misuse, fueled by disease mongering, aggressive marketing campaigns made by producers of health technologies, and direct consumers' advertising. In fact, not only the effectiveness, but also the risks of these new devices often are not evaluated accurately before their widespread and uncritical adoption. In the *pre*-hospital and emergency medicine field, for example, mechanical chest compression devices have an inconsistent evidence of effectiveness, whereas in emergency and critical care, colloids are still largely used for treatment of shock, in spite of their demonstrated lack of effectiveness, higher costs and risks respect to crystalloids.

Nonetheless, considering a broader definition of medical technology embracing not only devices and procedures, but also the way health services are organized and delivered, there are many aspects of the emergency health system which can be analyzed from this perspective. Thus, the apparently trustworthy belief on the capacity of advanced life support (ALS) to improve the outcomes of out-of-hospital cardiac arrest has been challenged by several lines of evidence, going from randomized controlled trials to epidemiological studies, where a substantial advantage of ALS over a well defined system already optimized for basic life support has not been demonstrated. Also, for *pre*-hospital management of major traumas, as recently pointed out by the World Health Organization, evidence of effectiveness decreases as complexity of organization, expenditures and technologies devoted to *pre*-hospital trauma systems increases (law of diminishing returns). We also cite the case of how it is difficult to disentangle the benefits of costly helicopter emergency medical services from the cures offered by major trauma centers and a well organized regionalized system of trauma care. The overcrowding of emergency departments is another good example of the inherent complexity of a problem still requiring a careful evaluation of all the input, throughput and output components, as well as the proper definition of relevant metrics and outcomes, for which no *magic bullet* solutions have been found so far.

Unfortunately, the traditional research approaches aiming to address and resolve the emergency health care questions above mentioned failed to identify the complex tradeoff between degree of innovation, marginal benefits, effectiveness, costs, safety, equity of access, impact on health organization and fairness of new technologies. So, the health technology assessment (HTA), defined as the multi-disciplinary field of policy analysis that examines the medical, economic, social and ethical implications of the incremental value, diffusion and use of a medical technology in health care, is intended to provide a bridge between the world of the biomedical research and that of the decision-making. In this sense, HTA is a tool to advise policymakers, patients and physicians to locate properly the value of a technology within its lifetime cycle, the potential role and effects of its adoption according to a multidisciplinary evaluation framework, helping to prioritize the most useful, cost effective and promising within the economic constraints of public health systems, as well as to identify areas of uncertainty needing further research or careful synthesis of existing evidence, and to inform the adoption and coverage decisions. This approach reveals its usefulness with increasing level of complexity of interventions, not amenable to classic investigation methods such as randomized trials, or when there is lack of studies in the early lifetime (*cutting edge* or *leading edge*) of the *technology blade* by Mikhail *et al*.,[1] requiring *ad hoc* methods such as horizon scanning, coverage under evidence development, payback decisions and other interpolation systems used to assess their potential impact and/or to steer their controlled introduction in the health system. In any case, HTA can offer a substantial contribute to decide the wise allocation of the limited resources devoted to health care, and to stop the relentless rise of health care wastes (such as over treatment, failure of care co-ordination and processes, pricing failures, over diagnosis and defensive medicine), seriously threatening the sustainability of publicly based health care systems, and respecting the *law of diminishing returns,* according to Donabedian's definition:[2]

The balancing of improvements in health against the cost of such improvements. The definition implies there is a best or optimum relationship between costs and benefits of health care, a point below which more benefits could be obtained at costs that are low relative to benefits and above which additional benefits are obtained at costs too large relative to corresponding benefits.

The multidisciplinary approach and the broadened perspectives allowed by HTA could be extremely useful in the *pre*-hospital and emergency care settings, for the reasons above

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explained, and considering the particular scope and remit of emergency medicine, at the crossroad between primary and higher levels of care, with special theme convergence with public health issues and considering the big direct and indirect costs emergency medicine moves through its role of gatekeeper of the hospital based health system. However, there is limited evidence that this nowadays occurs and this constitutes a major knowledge and research gap in the emergency medicine field. According to the north American counterpart of HTA, the comparative effectiveness research program recently set forth, the attention has also been directed toward time sensitive and episodic emergency care. Therefore, a conceptual framework for HTA/comparative effectiveness research has been proposed to describe a HTA roadmap for emergency medicine, going from the prioritization of populations and conditions to be studied in *real world* settings, using adequate study methods, outcome measures and the proper dissemination and translation of the results. A similar HTA approach could also be useful for European *pre*-hospital and emergency care systems, to inform policy-makers and clinicians on how to wisely decide on devices, technologies, and clinical pathways for time-sensitive emergent conditions, especially when costly and co-ordinated efforts on a hospital wide or regional/national basis are required.

Nonetheless, this ambitious program needs to be fostered and implemented through the involvement of many experts able to address the complexity underlying the questions cited, with openly methods and in an accountable, conflict-of-interest-free way. How many emergency physicians do have the know-how to do so, with the required expertise of evidence based medicine, risk management, economic analysis, ethic issues, legal questions, health care policy, organizational and teamwork theories is unknown. On the other hand, it is unlikely that any medical sub-specialty will produce specialists with the knowledge, skills and attitudes necessary to steer a HTA approach autonomously. Maybe this process would help emergency medicine to open wide its research and operational perspectives, shifting its paradigm from an obsessive attention to targets of questionable benefit for the patients and the society to a more ethical, sustainable and evidence based approach, *i.e.* from an *output driven* to an *outcome driven* emergency medicine model.

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