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SPECIAL PAPER

# Apps and intensive care medicine☆

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**Abstract** Technological advances have played a key role over the last century in the development of humankind. Critical Care Medicine is one of the greatest examples of this revolution. Smartphones with multiple sensors constitute another step forward, and have led to the development of apps for use by both professionals and patients. We discuss their main medical applications in the field of Critical Care Medicine.


**PALABRAS CLAVE**
Cuidados intensivos;
Aplicaciones móviles;
Teléfono inteligente;
Tableta

***Apps* y Medicina Intensiva**

**Resumen** Los avances tecnológicos han sido clave en el último siglo para el desarrollo de la humanidad. La Medicina Intensiva es uno de los mayores exponentes de esta revolución. Los teléfonos inteligentes *(smartphones)* con múltiples sensores son un paso más en este avance y han dado lugar al desarrollo paralelo de las aplicaciones *(apps)* para uso tanto por profesionales como por pacientes. Comentamos las principales aplicaciones médicas en el ámbito de la Medicina Intensiva.


## Introduction

Technological advances have been a significant element for the evolution of mankind during the last century. Basically it has been due to the still unrecognized ''computing revolution'', that has allowed us to change all areas of our society and has revolutionized Medicine. Intensive Care Medicine is one of the best examples of this revolution due to all

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the technologies available today for all kinds of support for organic systems.

Since the birth of mobile phones, in 1973, when the Motorola CEO, Martin Cooper made the very first phone call with a DynaTAC 8000X to his fiercest competitor, this industry has experienced an unstoppable growth. The real blooming of these technologies would occur in 2007, when charismatic Steve Jobs brought us the first generation of the iPhone®, introducing the revolutionary concept of using touch-screen technology instead of physical keyboards, changing from that moment onwards the way would we interact with these devices. The launch of the App Store followed – one repository of applications compatible with this device that provides an extra of security and reliability.

The technological advancement experienced during the last years was due to various factors that determined the great advancement of mobile and portable devices:

- *Hardware:* the high capacity of computing reached with the development of smaller and more energy efficient microchips; the blooming of smartphones that has reduced costs and made these devices a global phenomenon; and the development of different activity sensors that monitor vital signs and other biological functions—also blooming during the last year thanks to wearable devices.
- *Software:* the development of easier, safer and more user friendly-operating systems, and the development of mobile applications (apps).
- Conectivity: with global access to the Internet from any devices thanks to wireless (Wi-Fi) and data (3G, 4G, etc.) networks.

## eHealth

As it occurs in other fields, Medicine has also experienced the changes brought by this computing revolution through the vision of electronic health, *eSalud* or *eHealth*, based on information and communication technologies.

Mobile health or *mHealth* has potential applications in public health issues since it grants access to healthcare resources to a wide array of people, and without saturating the system since it reduces consultations, hospital stays, and healthcare costs.[1] In industrialized countries it is seen as an alternative that may solve the problem of costs and access to healthcare of an increasingly ageing population, while in developing countries and thanks to the arrival of mobile technologies to these countries, it will grant access to healthcare to the majority of low income-populations who live in rural areas.

As part of the *eHealth*, the electronic health records (EHR) and the data collected through apps will be used and analyzed trough the so-called Big Data. It will be a game changer as it has been the case in other industries where it was implemented some time ago—like Internet browsers that offer individual results based on prior searches. Applied to healthcare it can mean the development of tools that will assist us in the clinical decision making process, in the individualization of recommendations for every patient, or in the sending of these recommendations directly to patients—thus improving clinical practice, and the quality and efficiency of healthcare.[2]

However, there is still a big jump between the potential benefits of this technology and its real translation into healthcare systems, with certain challenges and setbacks still unresolved today such as feasibility, reliability, stability, privacy, security and friendly use of these systems, as we will see later.

## Apps and medicine

Nowadays, there is a great variety of applications generically related to health, some for patients and some for healthcare providers. And yet despite the great amount of apps that repositories have to offer, not many are backed by scientific evidence, not even weak evidence.

There is a group of apps oriented towards the use of these technologies by patients that try to improve health in various ways:

- *Primary prevention:* used to control blood pressure, body weight, etc.
- *Health training:* apps that help identify the signs and symptoms of different diseases so that we know when to ask for medical assistance, like the app designed by the *American Heart Association* on how to recognize strokes.
- *Process to facilitate self-care and guided therapies:* patient-focused apps have major implications in treatment since the patient is not a passive subject anymore in the healthcare process and acquires self-care responsibilities, which increases adherence to treatment. Today there are multiple diseases like diabetes,[3] COPD,[4] asthma,[5] or obesity,[6] or processes like smoking deshabituation,[7] weight loss[8] and other prevalent conditions,[9] where new technologies allow us to monitor and better control these conditions, even though the evidence behind this is still scarce.[10]
- *Rehabilitation:* there are experiences of cardiac telerehabilitation after suffering a myocardial infarction,[11] and also for the management of strokes the first experimental studies have been proposed, comparing tele-rehab with mobile devices and sensors monitored by therapists to conventional therapy.[12] This can result in a wide use of therapies with the same aviable means, with the obvious benefit for society.

This plan can also change the actual paradigm of Medicine by allowing, in an economically feasible way, the outpatient control of patients with chronic diseases through apps certified by healthcare authorities that would guide them in the home control of their conditions and assist them on when to ask for medical assistance, which in a not so remote distant future would turn doctors into prescribers of treatments, drugs, and apps. When it comes to patients requesting admission in intensive care units, with these apps we would be able to assess their clinical situation and prior outpatient control.

Also, the arrival of new technologies brings many changes in many settings of the development of the medical profession. During the last years we have seen the blooming of smartphones both for healthcare providers and the general