

Medical device software: defining key terms

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ABSTRACT

Introduction: one of the areas of significant growth in medical devices has been the role of software – as an integral component of a medical device, as a standalone device and more recently as applications on mobile devices. The risk related to a malfunction of the standalone software used within healthcare is in itself not a criterion for its qualification or not as a medical device. It is therefore, necessary to clarify some criteria for the qualification of stand-alone software as medical devices

Materials and methods: Ukrainian, European Union, United States of America legislation, Guidelines developed by European Commission and Food and Drug Administration's, recommendations represented by international voluntary group and scientific works. This article is based on dialectical, comparative, analytic, synthetic and comprehensive research methods.

Conclusion: the legal regulation of software which is used for medical purpose in Ukraine limited to one definition. In European Union and United States of America were developed and applying special guidelines that help developers, manufactures and end users to difference software on types standing on medical purpose criteria. Software becomes more and more incorporated into medical devices. Developers and manufacturers may not have initially appreciated potential risks to patients and users such situation could have dangerous results for patients or users. It is necessary to develop and adopt the legislation that will intend to define the criteria for the qualification of medical device software and the application of the classification criteria to such software, provide some illustrative examples and step by step recommendations to qualify software as medical device.

KEY WORDS: medical device software, stand-alone software, medical purpose, guidelines, criteria of differences.

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INTRODUCTION

Software is becoming increasingly important and pervasive in healthcare. Given the availability of a multitude of technology platforms (e.g., personal computers, smart phones, network servers, etc.), as well as increasing ease of access and distribution (e.g., internet, cloud), software created for medical purposes (software used to make clinical decisions) and non-medical purpose (e.g., administrative, financial) are being used in healthcare [1].

MATERIALS AND METHODS

This study is based on Ukrainian technical regulation acts, Council Directive 93/42/EEC, European Commission Guidelines on the qualification and classification of standalone software, documents that provide an international voluntary group of medical device regulators, Guidance for the Content of Premarket Submissions for Software Contained in Medical Devices that works in USA, scientific works and opinions of progressive-minded people in this sphere. In article were used next methods: dialectical, comparative, analytic, synthetic and comprehensive.

RESULTS AND DISCUSSION

In accordance with Ukrainian technical regulation of Medical devices, 'medical device' means any instrument, apparatus, appliance, **software... including the software intended by its manufacturer to be used**

specifically for diagnostic and/or therapeutic purposes and necessary for its proper application, intended by the manufacturer to be used for human beings for the purpose of: diagnosis, prevention, monitoring, treatment or alleviation of disease; diagnosis, monitoring, treatment, alleviation of or compensation, for an injury or handicap; investigation, replacement or modification of the anatomy or of a physiological process; control of conception - and which does not achieve its principal intended action in or on the human body by pharmacological, immunological or metabolic means, but which may be assisted in its function by such means [2]. This definition duplicates the same definition providing in Council Directive 93/42/EEC from 14 June 1993 concerning medical devices. [3] As we can see legislation refers software to the category of medical devices if it is used by users with medical purpose.

Unfortunately, the legal regulation of software which is used for medical purpose in Ukraine limited to this definition.

MEDICAL DEVICE SOFTWARE: DEFINITION, TYPES, CRITERIA OF DIFFERENCES

One key question medical software developers encounter related to compliance with international standards is whether or not their products actually qualify as medical devices in and of themselves. But medical device regulators in the US, Europe, Japan and other markets have begun

addressing some of the challenges that arise when software and medical devices converge. In Europe, for example, regulators have suggested the following categories of software that functions as a medical device [4]:

- 1) *Software that is a component and integral part of a medical device;*
- 2) *Software as a medical device (also known as stand-alone software), including apps.*

With the first category, there are no problem, software which is a component of medical device automatically is viewed as a medical device. But with second category it is not so simple.

Software can be used for a large variety of medical purposes [5]. In that respect the arguments do not differ from those used for other medical devices. Standalone software can directly control an apparatus (e.g. radiotherapy treatment), can provide immediate decision triggering information (e.g. blood glucose meters), or can provide support for healthcare professionals (e.g. ECG interpretation).

Not all standalone software used within healthcare can be qualified as a medical device.

The risk related to a malfunction of the standalone software used within healthcare is in itself not a criterion for its qualification or not as a medical device. It is therefore, necessary to clarify some criteria for the qualification of stand-alone software as medical devices [6].

EC'S GUIDELINES ON THE QUALIFICATION AND CLASSIFICATION OF STANDALONE SOFTWARE

There is special document in EU which consist guidance of standalone healthcare software. Its name is *EC's Guidelines on the qualification and classification of standalone software* published in January 2012. The document gives some guidance regarding the necessary steps to qualify standalone software as medical device.

Decision step 1: if the stand-alone software is a computer program, then it may be a medical device. If the software is not a computer program, then it is a digital document and therefore not a medical device.

Examples of computer programs are software applications, macros, scripts, dynamically linked libraries, batch files, style sheets and any document containing active formatting or filtering instructions. Examples of digital documents are image files, DICOM files, digital ECG recordings, numerical results from tests and electronic health records (EHR).

Decision step 2: if the software is incorporated into a medical device rather than standalone software, it must be considered as part of that medical device in the regulatory process of that device. If it is standalone software, proceed to decision step 3.

Decision step 3: if the software does not perform an action on data, or performs an action limited to storage, archival, communication, 'simple search' or lossless compression (*i.e.* using a compression procedure that allows the exact reconstruction of the original data) it is not a medical device.

Altering the representation of data for embellishment purposes does not make the software a medical device. In other cases, including where the software alters the representation of data for a medical purpose, it could be a medical device.

'Simple search' refers to the retrieval of records by matching record metadata against record search criteria, *e.g.* library functions.

Simple search does not include software which provides interpretative search results, *e.g.* to identify medical findings in health records or on medical images.

Software which is intended to create or modify medical information might be qualified as a medical device. If such alterations are made to facilitate the perceptual and/or interpretative tasks performed by the healthcare professionals when reviewing medical information, (*e.g.* when searching the image for findings that support a clinical hypothesis as to the diagnosis or evolution of therapy) the software could be a medical device.

Decision step 4: an example of software for the benefit of individual patients is software intended to be used for the evaluation of patient data to support or influence the medical care provided to that patient. Examples of software which are not considered as being for the benefit of individual patients are those which aggregate population data, provide generic diagnostic or treatment pathways, scientific literature, medical atlases, models and templates as well as software for epidemiologic studies or registers.

Decision step 5: if the manufacturer specifically intends the software to be used for any of the purposes listed in Article 1(2) a of Directive 93/42/EEC, then the software shall be qualified as a medical device.

However, if only a non-medical purpose is intended by the manufacturer, such as invoicing or staff planning, it is not a medical device.

Decision step 6: if the software is an accessory to a medical device, it is not a medical device, but it falls under Directive 93/42/EEC. The legal definition of 'putting into service' requires that a device is made available to the final user/operator as being ready for use on the Community market. Software made available to the user over the internet (directly or via download) or via *in vitro* diagnostic commercial services, which is qualified as a medical device, is subject to the medical devices directives [6].

Guidance for the Content of Premarket Submissions for Software Contained in Medical Devices

The same guidelines there is in US. They are named as *Guidance for the Content of Premarket Submissions for Software Contained in Medical Devices*. The document was issued on May 11, 2005. This guidance represents the Food and Drug Administration's (FDA's) current thinking on this topic and is intended to provide information to industry regarding the documentation that we recommend you include in premarket submissions for software devices, including standalone software applications and hardware-based devices that incorporate software [7].

IMDRF SAMD WORKING GROUP: SOFTWARE AS A MEDICAL DEVICE: KEY DEFINITIONS

Besides, International Medical Device Regulators Forum (a voluntary group of medical device regulators from around the world who have come together to build on the strong foundational work of the Global Harmonization Task Force on Medical Devices (GHTF), and to accelerate international medical device regulatory harmonization and convergence [8]) produce the document which provide regulators with the fundamental building blocks and a common understanding of the many kinds and importance of software for medical purposes in advancing public health [9].

The IEC 60601 standard and medical device software

Although the field of medical device software is still relatively new, the breadth and depth of standards addressing this sector has grown in recent years.

In the standards domain, IEC 60601-1-4 *Medical Electrical Equipment: Part 1-4: general requirements for collateral standard: Programmable Electrical Medical Systems* was published in 1996. As part of the IEC 60601 family of standards, this standard applied only to software as a component of a medical device. The third edition of IEC 60601-1, *Medical electrical equipment - Part 1: General requirements for basic safety and essential performance*, published in 2005, was a major revision of the standard, and included most of the content of IEC 60601-1-4 as clause 14. With that third edition published, IEC 60601-1-4 could be withdrawn.

IEC 62304 FOR STAND-ALONE AND COMPONENT MEDICAL DEVICE SOFTWARE

IEC 62304 *Medical device software - Software life cycle processes* was published in 2006, covering both software as a component of a medical device and standalone software (a medical device in its own right). IEC 62304 is the only international standard for medical software that has been recognized in many jurisdictions.

IEC 62304 introduced several aspects, in particular the idea that development of safe medical software requires both quality management and risk management, and further that the requirements of the standard are based on the software safety classification – class A, B or C.

When IEC 62304 was published, there were many questions from users (industry and conformity assessment bodies) on the implementation of the standard. In response to these questions, industry and the EU Notified Bodies decided to develop a set of FAQs (Frequently Asked Questions). These were based on more than 100 real-life questions, and were adopted and published by NB-MED in 2013. The FAQs were also used as input to maintenance of the standard, culminating in the publication of Amendment 1 to IEC 62304 in May 2015.

IEC 82304: A DEDICATED HEALTH SOFTWARE SYSTEM STANDARD

During the development of the amendment to IEC 62304, it was considered that, while for software driving (hardware)

medical devices there is a referencing “system standard” in IEC 60601-1, there is no similar referencing system standard for software-only products in the medical domain. Further consideration of the increasing grey zone between which software product are medical devices and which are not, led to the consideration of a systems standard for “Health Software.” Subsequently, work on such a system standard started; this will become IEC 82304-1[4].

The scope of IEC 82304-1 intersects the scope of IEC 62304 but is not identical. It includes different types of software and different steps of the software lifecycle. IEC 82304-1 deals with health software. The definition of health software is given in the section 3.6 of the standard: *HEALTH SOFTWARE* intended to be used specifically for maintaining or improving health of individual persons, or the delivery of care. It is completed with the definition of health software product in the section 3.7 of the standard: *HEALTH SOFTWARE PRODUCT* combination of *HEALTH SOFTWARE* and *ACCOMPANYING DOCUMENTS*.

The definition of medical device software, given at section 3.x of IEC 62304-2015 is different from the definition of health software: *MEDICAL DEVICE SOFTWARE*.

SOFTWARE SYSTEM that has been developed for the purpose of being incorporated into the *MEDICAL DEVICE* being developed or that is intended for use as a *MEDICAL DEVICE*.

Note: This includes a *MEDICAL DEVICE* software product, which then is a *MEDICAL DEVICE* in its own right. The definition of *SOFTWARE PRODUCT*, which was used in IEC 62304:2006, was removed from IEC 62304:2015. We now have the definition of *HEALTH SOFTWARE PRODUCT* in IEC 82304-1. This is one proof, amongst others, to make IEC 82304-1 and IEC 62304 a two-standard team.

Types of software regarding the medical intended use

The first main difference between both definitions is the intended use. IEC 62304 deals only with software with medical intended use, whereas IEC 82304-1 deals with any kind of software, which directly or indirectly has an effect on health.

The scope of IEC 82304-1 is broader than the scope of IEC 62304. The following types of software are in the scope of IEC 82304-1 but not IEC 62304: Radiology Information Systems (RIS), Prescription Management Systems (PMS), Laboratory Information Management Systems (LIMS), Mobile Apps, which are not Mobile Medical Apps, according to the [FDA Guidance on this subject](#), Software, which are not qualified as medical devices, according to the [MEDDEV 2.1/6 EU Guidance](#).

Thus, IEC 82304-1 includes in its scope standalone software, which are not regulated as medical devices [10].

MOBILE HEALTH APPS AS MEDICAL DEVICES

We would like to pay attention to the issue of Mobile health apps as medical devices. In the last few years, a phenomenon has begun to take shape that has the ability to transform medical practice and health care as we know it [11]. App developers have created health apps for almost

everything: apps that measure vital signs such as heart rate, blood glucose level or brain activities; apps that provide health related communication, information and motivational tools; apps that process photos of the patient's skin and send them to the dermatologist; [12] apps that help diabetic patients manage their daily routine by visualizing patterns in their blood sugar curve; [13] even apps that monitor medication compliance by collecting physiological data from a sensor that the patient swallows. [14] As Apple put it: "There's an app for that!" [15].

In its Green Paper on mHealth published in April 2014,5 [16] the European Commission (EC) explained that mHealth covers "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices," as well as "applications such as lifestyle and wellbeing apps as well as personal guidance systems, health information and medication reminders provided by SMS and telemedicine provided wirelessly." [17]

There are two categories of health-related apps, which are broadly called mHealth apps [18] (although the distinction is not always straightforward): (a) apps for the purpose of prevention, diagnosis and treatment of diseases (medical apps); and (b) apps relevant to lifestyle, fitness and well-being (nonmedical apps).

As others, standalone software mHealth apps is considered a medical device and falls under the scope of regulation only if it has a «medical purpose».

In UK, for example, there are a number of words likely to contribute to Medicines & Healthcare Products Regulatory Agency determining if an app is a medical device. These include: amplify; analysis; interpret; alarms; calculates; controls; converts; detects; diagnose; measures; monitors.

Examples of software apps include:

- apps acting as accessories to medical devices such as in the measurement of temperature, heart rate, blood pressure and blood sugars could be a medical device as are programmers for prosthetics could be classed as medical devices
- apps with software that monitors a patient and collects information entered by the user, measured automatically by the app or collected by a point of care device may qualify as a medical device if the output affects the treatment of an individual
- apps with software that provides general information but does not provide personalized advice, although it may be targeted to a particular user group, is unlikely to be considered a medical device
- apps with software that is used to book an appointment, request a prescription or have a virtual consultation is also unlikely to be considered a medical device if it only has an administrative function [19]

In EU in accordance with EC Guidelines on the Qualification and Classification of Stand Alone Software Used in Healthcare within the Regulatory Framework of Medical Devices an mHealth app is not a medical device if it merely performs an action limited to storing, archiving, compressing or transferring medical data, without interpreting/altering it.

[19] The same applies to an app limited to collecting and transmitting medical data from a(n) (in vitro) diagnostic medical device in the home environment to a doctor, without modifying its content. Equally, apps performing basic arithmetic operations, or plotting results in function of time, are not considered in vitro diagnostic medical devices.

However, according to the Guidelines, the Directives do apply to tools combining medical knowledge with patient-specific physiological parameters. In addition, apps providing immediate decision-triggering information, or altering the representation of data in a way that contributes to the interpretative or perceptual tasks performed by medical professionals, generally pose a risk for the patient's health and are subject to the Directives. Likewise, apps intended to provide additional information that contributes to diagnosis and/or treatment (e.g., generate alarms) are qualified as medical devices [20].

When it comes to mobile applications in the US the Draft Guidance states that the FDA will apply regulatory oversight to apps that fall into one of three specific categories that it defines as mobile medical apps. First are apps that "are an extension of one or more medical devices by connecting to such a device for purposes of controlling the device or displaying, storing, analyzing, or transmitting patient-specific medical-device data." These apps include, but are not limited to those that: Enable a user to view medical images for diagnosis; Analyze, assess, or interpret electrocardiograms or electroencephalograms; Connect mobile platforms to vital-signs monitors, bedside monitors, or cardiac monitors; Control a blood-pressure cuff connected to a mobile platform that measures a person's blood pressure; Act as wireless remote controls or synchronization devices for MRI or X-ray machines.

Second are apps that "transform a mobile platform into a medical device by using attachments, display screens, or sensors, or by including functionalities similar to those of currently regulated medical devices." This category might include apps that: Connect wirelessly to a blood-glucose tester to display, calculate, trend, convert, or download results or act as a glucose meter; Act as an electronic stethoscope; Monitor sleep apnea or detect falls; Use the light source to treat and cure specific conditions; Score and interpret cognitive-testing results; Determine blood-donor eligibility.

The third category consists of apps that "allow the user to input patient-specific information and — using formulae or processing algorithms — output a patient-specific result, diagnosis, or treatment recommendation to be used in clinical practice." Such apps might: Act as calculators or use algorithms to produce an index, score, or scale, as in the Glasgow Coma Scale, pain index, or Apgar score; Calculate parameters associated with the use of radioisotopes or the amount of chemotherapy; Assist with patient-specific dosing; Calculate osteoporosis risk; Collect blood-glucose readings and caloric intake to help manage diabetes; Define disease stage or progression and provide a prognosis or predict a patient's response to treatment. The FDA proposes to regulate apps that fall into any of these three categories as medical devices. As such, they will be subject to the

regulatory process discussed here [21].

CONCLUSION

Ukrainian Technical regulations on Medical devices which determines that software could be a medical device enter into binding 01 July 2017. But for this moment Ukraine doesn't have neither official document nor practice or scientific recommendations as concerns medical device software, its types, criteria for the qualification as software for medical purposes etc. Taking into account software becomes more and more incorporated into medical devices, developers and manufacturers may not have initially appreciated potential risks to patients and users such situation could have dangerous results for patients or users. Furthermore, uncertainty about the criteria of dividing software on medical device software and not medical device software may give grounds for corruption abuses. To prevent such consequences, it is necessary to develop and adopt the legislation that will intend to define the criteria for the qualification of medical device software and the application of the classification criteria to such software, provide some illustrative examples and step by step recommendations to qualify software as medical device. Considering the trend of convergence of Ukrainian legislation with EU it is possible to base this document on EC's Guidelines on the qualification and classification of standalone software.

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