

Useful US Guidance on Device Software

Maria Donawa

Image: Digital Vision

The use of software in medical devices and their accessories has led to significant improvements in clinical diagnosis and treatment of a vast range of illnesses. However, to benefit patients and users, device-related software must be properly developed and tested before use. This article discusses a United States guidance document that describes the type of documentation needed to show that this has been done.

US requirements for device software

The United States (US) Quality System Regulation (QSR) (21 CFR 820) requires that all medical devices automated with computer software are subject to the design control requirements contained in section 820.30 of the QSR. An important part of design controls is the validation of the design, which ensures that medical devices meet user needs and intended uses. Design validation must include software validation for devices containing software. Design validation also requires that risk analysis is performed for devices, where appropriate. A requirement is appropriate unless the manufacturer can document justification otherwise. Therefore, it is important that companies recognise that risk analysis must also be applied to the software contained in the device as well as to other device-related aspects that are not related to or controlled by software.

Updated FDA reviewer guidance

In May 2005, the Food and Drug Administration (FDA) issued an updated guidance document¹ for industry. This provides information on the type of documentation that should be included in premarket submissions for hardware-based devices that incorporate software and for devices consisting of standalone software applications. The guidance document combines the recommendations in a previous software reviewer guidance document issued on 9 May 1998 and "Reviewer Guidance for a Premarket Notification Submission for Blood Establishment Computer Software" issued on 13 January 1997.

The guidance document applies to all types of premarket submissions, including premarket notification 510(k) submissions, premarket approval applications, investigational device exemptions, and humanitarian device exemptions. It is also important to note that the guidance covers

- firmware and other means for software-based control of medical devices
- stand-alone software applications
- software intended for installation in general-purpose computers
- dedicated hardware/software medical devices
- accessories to medical devices when those accessories contain or are composed of software.

The guidance does not cover software that is designed for production or process controls. Firmware is defined in ISO/IEC 12207.²

Other FDA guidance documents

The updated software reviewer guidance points out the importance of consulting other software guidance documents such as the FDA guidance on software validation,³ which was discussed in a previous article.⁴ The software validation guidance document is an important document because it explains how FDA interprets the requirements of the QSR concerning device software and also software used for production and process controls. It also explains the importance of designing and validating software within the framework of a defined software life cycle and integrating software lifecycle management and risk



Dr Maria E. Donawa

physician, pathologist and pharmacist with 25 years' regulatory experience, worked with the US FDA before becoming President of Donawa Consulting, an international consultancy firm, which provides clinical research, quality management system, regulatory affairs, and European Authorised Representative services to medical technology companies.

management activities. In some cases, medical device software includes software that uses off-the-shelf software. In this case, the software reviewer guidance recommends the use of the FDA guidance⁵ that was specifically developed for this type of software.

Consensus standards

The FDA Center for Devices and Radiological Health (CDRH) believes that conformance with recognised consensus standards can provide a reasonable assurance of safety and/or effectiveness for many applicable aspects of medical devices. Therefore, information submitted on conformance with these standards in a premarket submission can have a direct bearing on determining safety and effectiveness during the review of that submission. It should also be noted that many consensus standards have been developed with the participation of CDRH staff.

Thus, the updated software reviewer guidance states that FDA has harmonised the terminology and recommendations in the guidance document with ANSI/AAMI SW68:2001, which is a software lifecycle standard,⁶ and ISO 14971, which is the international standard for medical device risk management.⁷ Readers can review the entire list of FDA recognised standards related to software at www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfStandards/Results.CFM

Level of concern

A critical step in the appropriate use of the reviewer guidance is the determination of the “Level of Concern.” This refers to an estimate of the severity of injury that a device could permit or inflict, either directly or indirectly, on a patient or operator as a result of device failures, design flaws, or simply by virtue of employing the device for its intended use. In addition, to assist in determining the appropriate level of concern, the guidance recommends a description of the role of software in causing, controlling and/or mitigating hazards that could result in injury to the patient or the operator.

The guidance document defines three Levels of Concern: Major, Moderate and Minor and provides descriptive information and a series of questions to help determine which Level of Concern applies. For example, a question related to a Major Level of Concern is, “Prior to mitigation of hazards, could a failure of the Software Device result in death or serious injury, either to a patient or to a user of the device? For the complete list of questions, readers should refer to the guidance document.

The type and extent of software documentation that FDA expects to be included in a premarket submission for a software device depends on the Level of Concern. This is summarised in the guidance document (see also Table I).



Table I: Documentation based on Level of Concern.			
Software documentation	Minor concern	Moderate concern	Major concern
Level of Concern	A statement indicating the Level of Concern and a description of the rationale for that level.		
Software Description	A summary overview of the features and software operating environment.		
Device Hazard Analysis	Tabular description of identified hardware and software hazards, including severity assessment and mitigations.		
Software Requirements Specification (SRS)	Summary of functional requirements from SRS.	The complete SRS document.	
Architecture Design Chart	No documentation is necessary in the submission.	Detailed depiction of functional units and software modules. This may include state diagrams as well as flow charts.	
Software Design Specification (SDS)	No documentation is necessary in the submission.	Software design specification document.	
Traceability Analysis	Traceability among requirements, specifications, identified hazards and mitigations, and verification and validation testing.		
Software Development Environment Description	No documentation is necessary in the submission.	Summary of software life cycle development plan, including a summary of the configuration management and maintenance activities.	Summary of software life cycle development plan. Annotated list of control documents generated during development process. To include the configuration management and maintenance plan documents.
Verification and Validation (V&V) Documentation	Software functional test plan, pass/fail criteria, and results.	Description of V&V activities at the unit, integration, and system level. System level test protocol, including pass/fail criteria and tests results.	Description of V&V activities at the unit, integration and system level. Unit, integration and system level test protocols, including pass/fail criteria, test report, summary and tests results.
Revision Level History	Revision history log, including release version number and date.		
Unresolved Anomalies (bugs or defects)	No documentation is necessary in the submission.	List of remaining software anomalies, annotated with an explanation of the impact on safety or effectiveness, including operator usage and human factors.	

→ Additional topics

The guidance document also discusses the importance of software risk assessment and risk management that meets FDA expectations. For example, although FDA considers risk as the product of the severity of injury and the probability of occurrence, the guidance states that software failures are systematic in nature. That is, the probability of occurrence cannot be determined using traditional statistical methods. For this reason, the guidance recommends that the estimation of risk relating to the software device is based on the severity of the hazard resulting from failure, assuming that the failure will occur. In addition, the risk identification and controls techniques described in ISO 14971 are recommended.

A discussion of all the additional topics is beyond the scope of this article, however, one additional topic will be mentioned. A new terminology has been introduced, which is Software of Unknown Pedigree (SOUP). Advice is provided on the type of information that should be provided in a premarket submission related to this type of software. Readers should review the guidance document to obtain information on all additional topics covered in the guidance document.

Lack of specific European guidance

This article discusses US software requirements. Similar guidance on the information that should be included in a medical device Technical File for CE-marking does not exist. Therefore, some companies use relevant US guidance documents such as the one discussed in this article to develop the type of convincing software documentation that helps support claims of safety and performance related to software.

References

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3. FDA General Principles of Software Validation: Final Guidance for Industry and FDA Staff, 11 January 2002. This document can be obtained from the CDRH website: www.fda.gov/cdrh
4. M.E. Donawa, "US FDA Final Guidance on Software Validation," *Medical Device Technology*, **13**, 3, pp. 20–24 (2002).
5. FDA Guidance for Industry, FDA Reviewers and Compliance on Off-The-Shelf Software Use in Medical Devices, 9 September 1999. This document can be obtained from the CDRH website: www.fda.gov/cdrh
6. US standard, ANSI/AAMI SW68:2001, Medical device software — Software life cycle processes.
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Maria E. Donawa

Donawa Consulting,
Piazza Albania 10, I-00153 Rome, Italy,
tel. +39 06 578 2665, fax +39 06 574 3786
e-mail: medonawa@donawa.com www.donawa.com