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Medical Device Risk Management Overview

Application throughout the product lifecycle

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Introduction

- John Mann – Director RAQA
- Evergreen Research, Inc
  - Contract Design
  - Contract Manufacturing
  - Regulatory and Quality Consulting

- Presentation includes best practices from experiences and should not be viewed in absolute terms or requirements.

Risk Management Overview Agenda

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- Risk management introduction
  - Product life cycles
  - Risk management stakeholders
  - Risk management relationships
- Risk management in development
- Risk management in production
- Risk management in post production
- Key points for risk management

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Risk Management Introduction

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- A company manages risk management for whom?
  - Patients
  - Users
  - Maintenance personnel
  - Management
  - Investors
  - Society

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Risk Management – Some Key Terms

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- Harm
  - physical injury or damage to the health of people, or damage to property or the environment
- Hazard
  - Potential source of harm
- Hazardous situation
  - Circumstance in which people, property, or the environment are exposed one or more hazard(s)
- Risk
  - Combination of the probability of occurrence of harm and the severity of that harm
- Risk Analysis
  - Systematic use of available information to identify hazards and to estimate the risk
- ALARP vs ALAP/AFAP

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Risk Management – Overview

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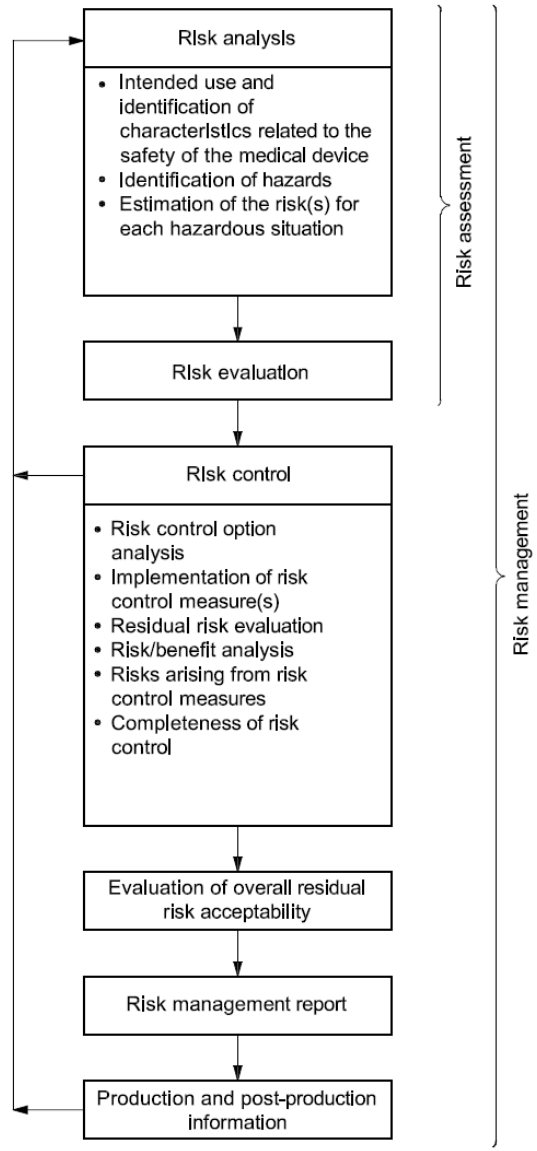

Risk Management is a living process

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Risk Management relationships

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- Product Standards
  - General Safety: 60601-1series
  - Usability: 62366-1
  - Software: 62304
  - Biocompatibility: 10993
  - Clinical: 14155
  - QMS: 13485
- Submissions
  - Technical Files
  - Essential Requirements
- Quality Management Systems
  - Inspection and test plans
  - Validation plans
  - Audit plans

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Risk Management – Development Design Planning

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- Phase 1: Design Planning
  - Scope of the risk management plan is related to risk of product
  - Planning for risk management – RMP, Annex F
    - Scope, assignments, risk activities, criteria, verification, activities related to collection and review of production and post production information
    - Risk control approach (e.g. hardware vs software)
    - Qualified personnel – design, clinical, & risk process
    - Management control and oversight
      - Provide adequate resources
      - Risk policy for determining criteria for risk acceptability
      - Review suitability and effectiveness of risk management process at planned intervals
        - Management review
        - Design Phase Reviews
        - Post Market Surveillance Reviews
        - Nonconformance escalations

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Risk Management – Development Design Input

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- Phase 2: Design Input
  - Preliminary Hazards, **Literature Review***, 14971 Risk Characterization**, Adverse Event Database Searches
    - * Literature review is a BOGO with CER.
    - ** Blank page start, Annex C
    - Particular standards or guidance documents

  - Known and foreseeable; normal and fault conditions
  - Use cases and uFMEA – BOGO with 62366-1
  - Identified risk mitigations become product requirements

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Risk Management – Development Design Output

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- Phase 3: Design Output
  - Bottom up or Top Down?
    - You need design output to perform bottom up
  - System architecture / BOM provide a roadmap to the product and the risk analysis

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Risk Management – Development
Risk Analysis Methods – Bottom Up

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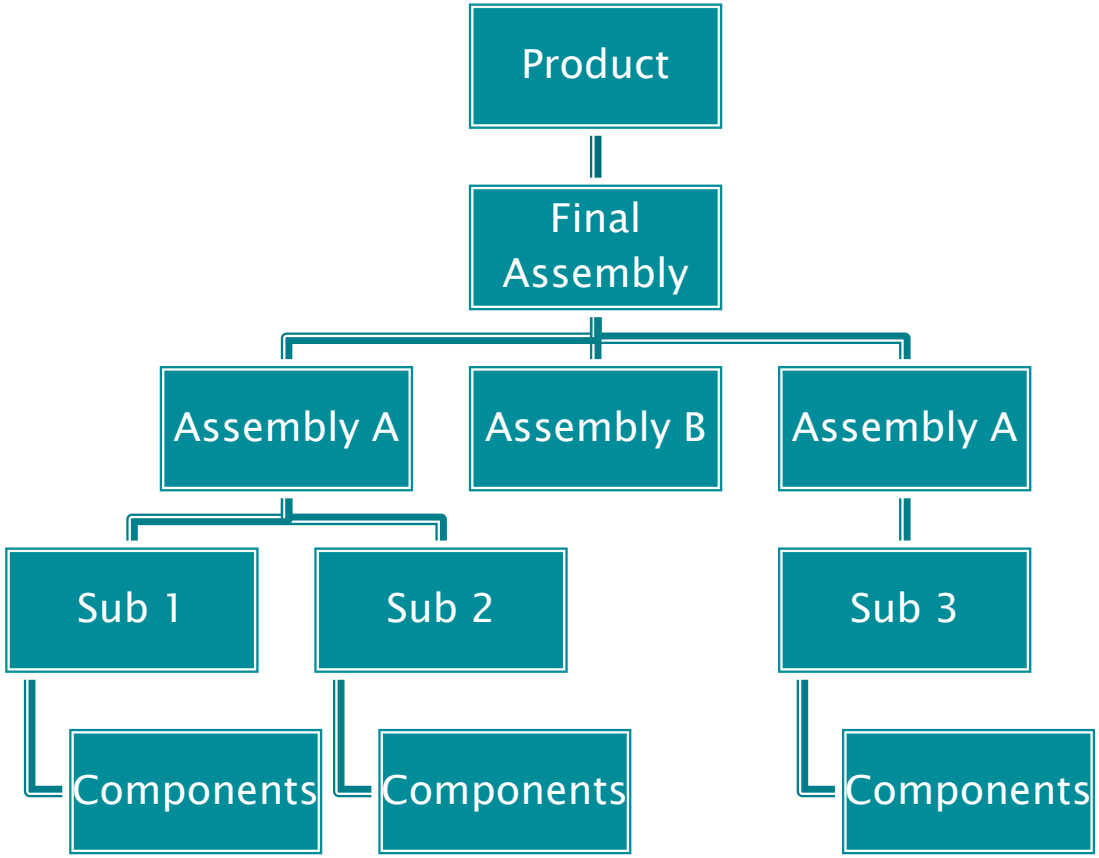

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Risk Management – Development
Risk Analysis Methods – Top Down

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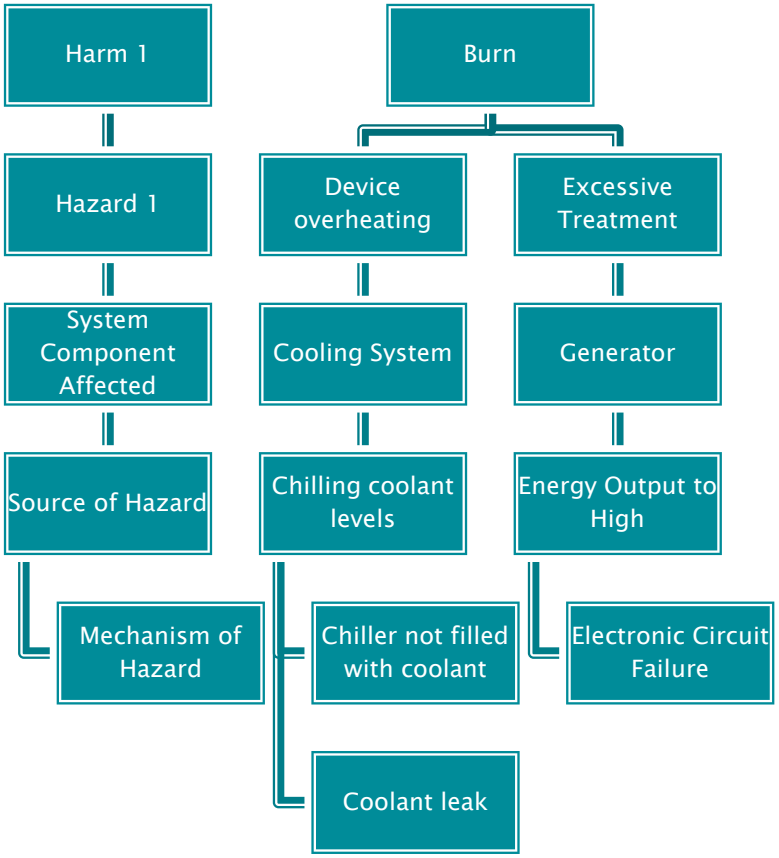

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Risk Management – Development Hazards Analysis

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- List hazards identified through preliminary hazards analysis, literature search, risk characterization, etc.
- Identify how the hazards can occur in the design – failure modes
- Risk ratings – Severity / Occurrence
- Identify as basic, use, or essential performance
- Identify any risk mitigations – link to requirements
- Risk ratings – Severity / Occurrence

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Hazard	Cause	System Component Affected	Source of Hazard within System	Mechanism of Hazard	S E V	O C C	RPN Before Mitigation	E.P.	Mitigation	S E V	O C C	RPN After Mitigation		Requirement trace for mitigation

1. If the risk priority number (RPN) is equal or below X, then the risk is acceptable and is not part of essential performance. These lines are marked “N”.
2. If the item is related to basic safety then the line is marked “B”.
3. If the item is related to a use error, then line is marked “U”.
4. The remaining items are marked “E”, which form the essential performance.

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Risk Management – Development dFMEA

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- List lowest level of analysis – components, lower subassemblies per risk management plan
- List the items intended function(s)
- Go through the five failure modes
  - Anti, Over, Under, Delayed, Intermittent
  - LED example: No light, too bright, too dim, not at right time, blinking
  - Not all functions are applicable
- List failure causes
- List resulting local and system effects
- Risk evaluation???

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Risk Management – Development dFMEA

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Component	Intended Function	Failure Mode	Cause	Local Effect	System Effect	S	O	RPN	Mitigation	S	O	RPN

Component	Intended Function	Failure Mode	Cause	Local Effect	System Level Effect	Hazard

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Risk Management – Development
Risk Controls

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- Inherent safety by design
- Protective measure in the medical device itself or in the manufacturing process
- Information for safety

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Risk Management – Development Design Verification

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- Risk based sampling approach
  - Based on confidence and reliability
  - Confidence – Type I error, alpha
  - Reliability – Type II error, beta
- Confidence and Reliability is proportional to the risk
  - Higher risk requires higher confidence and reliability
- Sample sizes are driven by confidence and reliability
  - Higher confidence and reliability required higher sample sizes

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Risk Management – Development Design Validation

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- Summative Usability
  - New risks identified?
- Simulated Use
  - New risks identified?
- Clinical Studies (integral to clinical process)
  - Clinical protocol
  - Informed consent
  - Investigator's brochure

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Risk Management – Development
Risk Management Report

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- Risk management plan has been appropriately implemented
- Overall residual risk is acceptable
- Appropriate methods are in place to obtain relevant production and post production information
- Risk vs Benefit ?

- Management oversight and review

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Risk Management – Production Process Risk

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- Same concepts as for design – top down, bottom up
- Try to leverage commonalities – assembly processes are typically all the same from a high level view point
  - Manual processes
  - Automated processes
- Add detection (SxOxD) as part of the risk evaluation and/or use the process control plan (analogous to design requirements, detection is a mitigation concept)
- Nonconformance Investigations based on process risk analysis

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Risk Management – Production
Risk Management Report – Update

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- Risk vs Benefit ?

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Risk Management – Post Production

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- Complaints
  - Investigation planning – use the failure modes and source of hazards to provide a road map to the investigation
- Adverse events
  - Use the risk management file to identify those items which meet the definition of an adverse event
- Post Market Surveillance
  - Risk profile the same?
    - Risk profile = S x O
    - Severity levels correct?
    - Occurrence rates as predicted?
    - New harms?
    - Identify potential corrections or CAPA?

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Risk Management– Key Points

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- Leverage risk management approaches across products and processes
- Remember the BOGOs
  - Comply with multiple standards and guidelines with the same effort
- Risk management file is a living document

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