Case for Quality
Company E
Risk Management
Risk Management

Quality System Interaction Diagram

Management Controls

Document Control/Records

Production and Process Controls

Supplier Controls

Sterilization Processes

Material Controls

Change

Design

Risk Mgmt Controls

Control

Corrective/Preventive Actions

Servicing Installation

Medical Device Tracking

Reporting Corrections/Removals

Medical Device Reporting

Facility and Equipment Controls

Supplier Controls

Change

Design

Risk Mgmt Controls

Control

Corrective/Preventive Actions

Servicing Installation

Medical Device Tracking

Reporting Corrections/Removals

Medical Device Reporting

Facility and Equipment Controls

Monitoring, Measuring, Feedback, Data Analysis

Modified from Guide To Inspections of Quality Systems, pg. 2 Diagram, Malaka C. Desrouches 6/16/1998 (FDA QST Manual)
Risk Management

- Risk Assessment
  - Intended Use and identification of characteristics related to the safety of the medical device
  - Identification of hazards
  - Estimation of the risk(s) for each hazardous situation

- Risk Evaluation

- Risk Control
  - Risk control option analysis
  - Implementation of risk control measure(s)
  - Residual risk evaluation
  - Risk / benefit analysis
  - Risks arising from risk control measures
  - Completeness of risk control

- Evaluation of Overall Residual Risk Acceptability

- Risk Management Report

- Production and Post-Production Information

Risk Management Process
Hazard Analysis Process Flowchart (1 of 2)

START

1. Identify scope/device for the hazard analysis

2. Describe device and its intended use (include end-user workflow from set-up, procedure and post-procedure)

3. Initiate hazard analysis

4. Identify hazards (known and foreseeable from normal and fault conditions)

5. Identify Sequences of Events leading to Hazardous Situations

6. Identify Hazardous Situations

7. Analyze Hazardous Situations to Identify harms which could result. Identify Harm Severity. (Use master harms list)

8. Is the identified harm on the Master Harms List?
   - Yes
   - No

9. Identify a Cause(s) for each identified Harm

10. Estimate Risk of a Hazardous Situation Leading to Harm

11. Evaluate risk

Acceptance Criteria (from Risk Management Plan)

Estimate the likelihood of a Hazardous Situation leading to Harm ($P_2$)

Estimate the probability of a Hazardous Situation ($P_1$)

Yes

TMP – Questionnaire for Hazard Identification Record

TMP – Hazard Checklist Record

WIF – Master Harms List

Revise master harms list

Evaluate risk

No

Broadly Accepted

IFRR

Intolerable
Risk Management

Hazard Analysis Process Flowchart (2 of 2)

Diagram:

12. Identify Risk Controls
13. Implement Risk Controls
14. Re-estimate Risk (P1, P2, and S) after implementation of Risk Controls
15. Identify Information for Safety
16. Have any new hazards or hazardous situations been introduced or have any existing risks been affected?
17. Risk acceptable?
18. Conduct Risk Benefit Analysis of Intolerable individual risks
19. More risks to evaluate?
20. Create Risk Summary and Individual Risk/Benefit Analysis (RBA) Summary

Acceptance Criteria (from Risk Mgmt. Plan)

Document in Hazard Analysis Worksheet

IFs

IFS

No

No

Yes

Yes

Yes

Yes

Yes

Yes

END
Software Hazard Analysis Flowchart

START

1. Determine Level of Concern (LOC)
2. Software Safety Classification
3. Column (4)(5)(6) Decompose System & Classify SW Items
4. Column (4)(5)(6) Documented Rationale for each SW Item if different from System

FDA Determination For 510(k)

LOC Determination

Software Safety Classification

Create SW Architecture

Column (2)(3) Sequences of Events

Hazardous Situations

Possible Effects of Hazardous Situations (Harms / Severity)

From System-Level Hazard Analysis

Provide Results to System Level Hazards Analysis for Effectiveness Evaluation

YES

NO

Document & Verify Traceability

Column (13) Does Risk Control Measure create new sequences resulting in Hazardous Situations?

COLUMN (10)

Include Risk Control Measure in Software Requirements

COLUMN (4)(5)(6)

(Re) Assign SW Safety Classification Based on Hazard Effects

COLUMN (11)

SW Item Development Plan

Identify Risk Control Type & Develop Risk Control Measures

ID, Evaluate & Document Potential Causes Contributing to Hazardous Situation

Include SOUP Anomalies

COLUMN (7)

COLUMN (8)

AYES

COLUMN (9)

Are Risk Control Measures to be Implemented as part of the SW?

Yes

COLUMN (12)

Verify & Document Implementation

Implement Risk Controls

No

Perform Only if Classification Changes

AFTER Documenting RCM in SW Requirements AND Documenting RCM in SW Item Development Plan AND (Re) Assigning Safety Classification (if necessary) THEN Implement Risk Control Measures
RM Through the Product Development Process

- Risk Management Plan(s)
- Preliminary Hazard Analysis → Hazard Analysis
- Use FMEA
- Design FMEA
- SW Hazard Analysis
- Process FMEA

Risk Management File

- Updates to Hazard Analysis
- Updates to UPFMEA
- Updates to DFMEA
- Updates to SWHA
- Updates to PFMEA

Risk Management Documents Updates

- Risk Reviews

Feedback from:
- CAPA
- Complaints
- NCRs
- Design Changes
- Process Changes
- Literature
- Other post-market surveillance
## Risk Management Process – Risk Analysis

### Risk Acceptability Criteria *

<table>
<thead>
<tr>
<th>Hazard Analysis</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severity of Harm</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>25</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>16</td>
<td>12</td>
<td>8</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>12</td>
<td>9</td>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>10</td>
<td>9</td>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>9</td>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>6</td>
<td>9</td>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>9</td>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

### Probability of Occurrence of Harm

- Intolerable
- IFRR – Investigate for Further Risk Reduction
- Broadly Accepted

### FMEA

<table>
<thead>
<tr>
<th>Description</th>
<th>RPN Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>49 - 125</td>
</tr>
<tr>
<td>Medium</td>
<td>13 - 48</td>
</tr>
<tr>
<td>Low</td>
<td>1 - 12</td>
</tr>
</tbody>
</table>

* The Risk Acceptability Criteria depicted in the chart above varies according to the product risk profile.
Risk Management

Sequence of events

1. Hazard
2. Hazardous situation
3. Harm

Exposure ($P_1$)

$P_2$

Severity of the harm

Probability of occurrence of harm ($P_1 \times P_2$)

Risk
## Sample Harms List

<table>
<thead>
<tr>
<th>Harm</th>
<th>Severity (10 pt scale)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Loss (&lt; 10% of BV)</td>
<td>3</td>
</tr>
<tr>
<td>Blood Loss (&gt;10 % and &lt; 40% BV)</td>
<td>5</td>
</tr>
<tr>
<td>Blood Loss (&gt;40% BV)</td>
<td>8</td>
</tr>
<tr>
<td>Burn (1(^{st}) degree)</td>
<td>2</td>
</tr>
<tr>
<td>Burn (2(^{nd}) degree)</td>
<td>4</td>
</tr>
<tr>
<td>Burn (3(^{rd}) degree)</td>
<td>6</td>
</tr>
<tr>
<td>Laceration (superficial)</td>
<td>3</td>
</tr>
<tr>
<td>Laceration (significant)</td>
<td>7</td>
</tr>
<tr>
<td>Death</td>
<td>10</td>
</tr>
</tbody>
</table>

Harms listed in the Harms List must be tied to complaint reporting and Hazard Analysis.
## Sample Hazard Analysis Worksheet

<table>
<thead>
<tr>
<th>Unique ID</th>
<th>Hazard</th>
<th>Pre-mitigation Risk Analysis</th>
<th>Risk Control</th>
<th>Post-mitigation Control Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[2]</td>
<td>[4]</td>
<td>[8]</td>
<td>[13]</td>
</tr>
<tr>
<td></td>
<td>Hazardous Situation</td>
<td>[5]</td>
<td>[9]</td>
<td>[14]</td>
</tr>
<tr>
<td></td>
<td>Harm</td>
<td>[6]</td>
<td>[10]</td>
<td>[15]</td>
</tr>
<tr>
<td></td>
<td>Severity of harm</td>
<td>[7]</td>
<td>[11]</td>
<td>[16]</td>
</tr>
<tr>
<td></td>
<td>Cause</td>
<td>[12]</td>
<td>[17]</td>
<td>[18]</td>
</tr>
<tr>
<td></td>
<td>Probability of hazardous situation (P₁)</td>
<td>[13]</td>
<td>[18]</td>
<td>[20]</td>
</tr>
<tr>
<td></td>
<td>Probability of harm (P₂)</td>
<td>[14]</td>
<td>[19]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Probability of Occurrence of harm (P₁ x P₂) = (O)</td>
<td>[15]</td>
<td>[19]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Risk Level (S x O)</td>
<td>[16]</td>
<td>[20]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Risk Acceptability</td>
<td>[17]</td>
<td>[20]</td>
<td></td>
</tr>
</tbody>
</table>

**Electrical Hazards < Hazard group category for this section**

**Thermal energy Hazards < Hazard group category for this section**

**Next hazard < Hazard group category for this section**
# Risk Management

## Sample Software Hazard Analysis Worksheet

<table>
<thead>
<tr>
<th>Software Hazard Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Name</td>
</tr>
<tr>
<td>Software System Safety Classification</td>
</tr>
<tr>
<td>(1) UID</td>
</tr>
<tr>
<td>HA UID</td>
</tr>
<tr>
<td>(4) SW Source(s)</td>
</tr>
<tr>
<td>(Module / Item / SOUP)</td>
</tr>
<tr>
<td>Type and Risk Control</td>
</tr>
<tr>
<td>(8) Risk Controls</td>
</tr>
<tr>
<td>(9) SW Part of SW ?</td>
</tr>
<tr>
<td>(Y/N)</td>
</tr>
<tr>
<td>(11) SW Dev Plan SW Design Doc or alternate Design Document</td>
</tr>
<tr>
<td>(Ref ID#)</td>
</tr>
<tr>
<td>(12) Risk Control Verification</td>
</tr>
<tr>
<td>(Ref. Ver. Protocol#)</td>
</tr>
<tr>
<td>(13) New Hazardous Situations?</td>
</tr>
</tbody>
</table>

Ref.: [AdvaMed](https://www.advamed.org)
## Risk Management

### Sample FMEA Worksheet

<table>
<thead>
<tr>
<th>Unique ID</th>
<th>I D</th>
<th>Risk Analysis Original State</th>
<th>Mitigation / Actions Taken</th>
<th>Post-Mitigation / Residual RPN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2a</td>
<td>Process Requirement</td>
<td>Risk Controls</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>Potential Failure Mode</td>
<td>Veriﬁcation</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>Occurrence (O)</td>
<td>Severity (S)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>Potential Effect of Failure</td>
<td>Detection (D)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>Potential Cause(s)/ Mechanism(s) of Failure</td>
<td>RPN = S x O x D</td>
<td>Final Risk Acceptability 18</td>
</tr>
</tbody>
</table>

1.0 Process Element #1:

2. Process element #2:

n.0 Process element #n:
Risk Management

Types of Risk Reviews

• Periodic
  – Period of review is based on product risk. Generally 6 months (high risk) to 2 years (low risk) period.

• Design or Process Change

  ▪ Product Specific
  ▪ Comprehensive
  ▪ Planned Intervals
  ▪ Monitors Risk Management File

  ▪ Product Specific
  ▪ Limited Scope
  ▪ Change to Product Design or Process
  ▪ Ensures Change Does Not Increase Risk
Risk Management

Types of Risk Reviews

• Ad-Hoc
  ▪ May be Product Specific
  ▪ Limited Scope
  ▪ Response to Unique Event

• Management Review
  ▪ Includes All Products
  ▪ Defined Intervals
  ▪ Limited Scope
  ▪ Monitors Risk Management Process
  ▪ Part of Management Review Meetings
Risk Review Inputs

• Who is involved with a periodic risk review?
  • Design Quality Assurance - Leader
  • Marketing
  • Site Quality
  • Regulatory Affairs
  • Post-Market Engineering
  • Service
  • Clinical Services
  • Product Development
  • Product Surveillance
  • Operations Engineering
  • CAPA Quality Assurance
Information for Risk Review

Design Quality Assurance shall provide:

- Documentation from the last Periodic Risk Review (PRR), as well as any Ad-Hoc Risk Reviews during that period.
- Action items from the last PRR and any Ad-Hoc Risk Reviews during that time, along with rationale for any incomplete items.
- Changes to internal procedures or policies that would require alteration of existing documents, and the proposed plan to address them.

Marketing shall provide:

- Customer feedback, including any documented market research information.
- Information about product marketing that involves safety features.
- Information about similar devices on the market.

Product Surveillance shall provide:

- List of all actual harms that have been reported since the last Periodic Risk Review.
- Information about the rates of failure modes and causes.
- Information about any new risks or hazardous situations that have been identified.
- List of MDRs since the last Periodic Risk Review, for both the product under review and similar Terumo products.
- List of MDRs on competitive products since the last Periodic Risk Review.
Information for Risk Review

**Operations Engineering shall provide:**
- Information regarding the types and quantities of Nonconformance Report (NCR) causes since the last Periodic Risk Review.
- NCR summary including investigation and root cause, as requested by the risk review DQA Representative.

**Supplier Quality Engineering shall provide:**
- Information about supplier-related NCRs and Supplier Corrective Action Requests (SCARs), including types and quantities of issues, since the last Periodic Risk Review.

**Regulatory shall provide:**
- List of recalls performed for the product since the last Periodic Risk Review, including the background and reason for each recall.
- List of recalls on competitive products since the last Periodic Risk Review.
- New or revised standards since the last Periodic Risk Review.
Risk Management

Information for Risk Review

Post-Market Engineering shall provide:
• Summary listing of design / process change risk reviews since the last Periodic Risk Review.

Service shall provide (as applicable):
• Information about the types and quantities of repairs since the last Periodic Risk Review.
• Information about the parts replaced on products in the field (US and International).
• Information about trends in repairs and parts usage.
• Other serviceability and usability issues.

Clinical Services shall provide:
• Information related to changes in the market such as:
  — Common or suspected off-label use
  — Changes in clinical technique
  — International uses and practices
• Information from clinical literature (e.g., journals) that are relevant to Terumo CVS products, including safety issues and actual incidents.
• Any further information about product usability, clinical practices, and related issues.
Information for Risk Review

**Product Development shall provide:**

- Design information that may be relevant to the product under review.
- Any known open issues related to the product functionality that may have a direct impact on the level of risk.
- Any new information about reliability, from new product projects or any other sources, which might affect the assessment of risk for the product. Consider expected service life, the need for preventive maintenance, and associated risks.

**CA/PA Quality Assurance shall provide:**

- A list of CA/PA Determinations generated by risk-based trending.
- Information about Failure Mode and Effects Analysis (FMEA) updates that may be needed, based on CA/PAs.