Implications of Artificial Intelligence and Advanced Analytics on Clinical Care, Surgery and the Medtech Business Model

The OR Black Box™

SPEAKER:
Prof. dr. Marlies P. Schijven
Surgeon Academic Medical Center Amsterdam
Chair on Simulation, Serious Gaming and Applied Mobile Healthcare

#MTF2016
Safety in Surgery: early thoughts

- hire competent individuals
- invest in training (simulation)
- follow standard operating procedures
- construct national guidelines
- use modern equipment
- have a system for casualty analysis

= Better patient safety?
Adverse event trends in healthcare

Training situational awareness to reduce surgical errors in the operating room.

Adverse events

Pilot study: 54 procedures, 66 adverse events in 38 of them, 75% unnoticed by the team.

- Haematoma or minor bleeding: 60%
- Thermal injury to non-target tissue: 6%
- Serosal tear: 8%
- Devascularization bowel edge after transsection: 9%
- Entangled or broken sutures: 5%
- Soft tissue injury: 2%
- Staple line failure: 11%

What can we learn from industry?

Black Box (1965)
In the early 60’s Air Canada was involved in the development of the multi-channel flight recorder.

In 1965, Royston Instruments, an English electronics company, with the assistance of Air Canada engineers, produced the multi-channel flight recorder – also known as the world’s first Black Box.
AMC krijgt zwarte doos in operatiekamer

Een van de operatiekamers van het AMC

Het AMC in Amsterdam krijgt als eerste ziekenhuis in Nederland een zwarte doos in een van de twintig operatiekamers. Daarop worden alle gegevens bijgehouden en geanalyseerd, net als in vliegtuigen het geval is.
Eerste zwarte doos staat in operatiekamer AMC
The Golden Circle

**WHAT**
Every organization on the planet knows WHAT they do. These are products they sell or the services

**HOW**
Some organizations know HOW they do it. These are the things that make them special or set them apart from their competition.

**WHY**
Very few organizations know WHY they do what they do. WHY is not about making money. That’s a result. WHY is a purpose, cause or belief. It’s the very reason your organization exists.

Simon Sinek.
Start with Why
WHY?

In order to enhance patient safety, people caring for them need and deserve the opportunity to learn from mistakes and suboptimal situations;

>before they may become errors with a consequence in future situations
Teaming up with Prof. dr. Grantcharov, Canada

Inventor of the OR Black Box™

Establishing Academic Medical Center in Amsterdam as EU reference center for OR Black Box
OR Black Box

OR Camera's
Audio
Laparoscopic camera
Patient physiology
Machines & Sensors

OR Black box™

St. Michael's Hospital
Operating room view

OR Black Box
256-bit algorithm encrypted files are pushed using a secure socket connection to Surgical Safety Technologies Servers, co-located at the St. Michael's Hospital Data Center in Toronto, Ontario, Canada.
Encrypted file transmitted over secure VPN to Surgical Safety data centre
Data analysis centre in Toronto, Canada
Analysis team

- surgical expert
- selection, training, certification & calibration process

**Selection** (background, knowledge & motivation)

**Didactic Curriculum** (lectures, references, video review)

**Review of video library + analysis software**

**Test** (theory and video analysis)

- 50% double review
- 10% double review
Software analysis – deep learning technology

**Initial Approach**
- Raters review the entire procedure

**Novel Method**
- Raters only watch surgery where algorithm predicts errors/events
- Prioritize Sensitivity

Diagram:
- Time Axis
- Rater’s viewing
- Example Surgical Error/Event
Perception engine

Input
- Surgical Audio
- Video
- Digital data

System
- Machine Learning Algorithm
- Supplementary Code

Output
- Timeline with Potential Surgical Event/Error Flags
Performance analysis

Technical Performance
• Generic Error Rating Tool (GERT)
• Objective Structured Assessment of Technical Skills (OSATS)

Non-Technical Performance
• Scrub practitioners’ intra-operative non-technical skills (SPINTS – SPLINTS)
• Non-Technical Skills for Surgeons (NOTSS)

Disruptions in Surgery Index (DISI)
• Environmental Distractions
Captures disturbances related to:

- Individual Issues
- OR Environment
- Communication
- Coordination and SA
- Patient-related disruptions
- Team Cohesion
- Organizational Disruptions
- Change Over
- Surgeon Role

Captures disturbances related to:

- **Individual Issues**
- **OR Environment**
- **Communication**
- **Coordination and SA**
- **Patient-related disruptions**
- **Team Cohesion**
- **Organizational Disruptions**
- **Change Over**
- **Surgeon Role**

Technical Error Analysis

*Click a Surgical Task to view errors

- Energy
  - Energy 14 (53.8%)
- Grasping/Dissection
- Suturing

- Energy
  - Inadequate Visualization 6 (42.9%)
  - Wrong Orientation
  - Inadequate Visualization
  - Force/Distance
Scrub Practitioners' List of Intraoperative Non-Technical Skills (SPLINTS)

* Click a Category to view Sub Categories

Communication & Teamwork - Coordinating with Others
- Circulating Nurse - Positive
- Circulating Nurse - Positive 2

Communication & Teamwork - Exchanging Information
- Circulating Nurse - Negative
- Circulating Nurse - Negative 1 (80%)

Communication & Teamwork
- Situational Awareness
- Communication & Teamwork
- Task Management

Scrub Practitioners
Disruptions in surgery
Video/audio of Operating Room
Endoscopic camera/Wearable tech
Patient physiology
Environmental factors (Tp, decibel level, room traffic etc.)
Devices

Operating Room Black Box

Opportunities for Use

Proactive assessment of risks/hazards
Root cause analysis of adverse events/outcomes
Individualized team training interventions
Safety evaluation of surgical technology
Assess efficiency
Clinical trial:
How satisfied are the participating OR team members with the use of the, by the Surgical Black Box® data analysis center generated, performance report as an instrument to evaluate the procedure as a team and in a structured way?

Secondary Objective(s):
- To analyze the conditions and possibilities of Surgical Black Box® implementation in the endoscopic OR at the AMC;
- To assess the OR team’s conscious awareness of incidents and adverse events in the OR (correlated with observed incidents and events as well as technical and non-technical performance by the Surgical Black Box, demonstrated in the generated performance report);
- To assess non-technical skills and team performance of surgeon, nursing and anesthesiology teams during these procedures;
- To create an educational support program for the OR team with the help of the ‘TOPPER-trial’ performance reports.