

Use of Surgical Robots on Cardiology Surgery: Advantages and Barriers for its Implementation

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AABRI International Conference

January 2, 2015

Introduction

- Robots are machines that perform complex actions controlled by a computer to replace human effort.
- Surgical robots replicate human movements to more precise motions, giving more accurate and delicate operations.

Introduction cont.

- Robotic surgery is a recent, innovative addition to minimally invasive surgery.
- The use of robotic surgery is not to replace surgeons but to assist.
- The most common use for robotic assisted heart surgery is the da Vinci System.

Historical Perspectives

- Early 1980's: U.S. Department of Defense and NASA introduced initial robotic technology
- 1985: First documented robotic surgery
- 1987: First robotic laparoscopic surgery
- 1990's: FDA approved Zeus robotic surgical system for endoscopic surgery
- 2000: FDA approved da Vinci robotic surgical system for general laparoscopic surgery

Robotic Utilization

- **Surgical disciplines utilizing robotics:**
neurology, orthopedics, gynecology, cardiothoracic, urology, and general surgery
- **Most common: Robot Assisted Radical Prostatectomy (RARP)**
- **In 2006, da Vinci RARP represented 10% of all radical prostatectomies in U.S.**
- **2008-2009, da Vinci RARP increased to 65% of all radical prostatectomies in U.S.**

Purpose

- The purpose of this research was to study the evolution of technical features of surgical robots on cardiology to determine technical advantages and barriers of these technologies.

Methodology

- Literature review utilizing 29 articles
- Databases searched: PubMed, Science Direct, EbscoHost, and Google Scholar
- Key Search terms: ‘cardiac’ OR ‘heart AND ‘robotic’ AND ‘surgery’
- Included articles from 2003-2013 in the English Language only.

Conceptual Framework

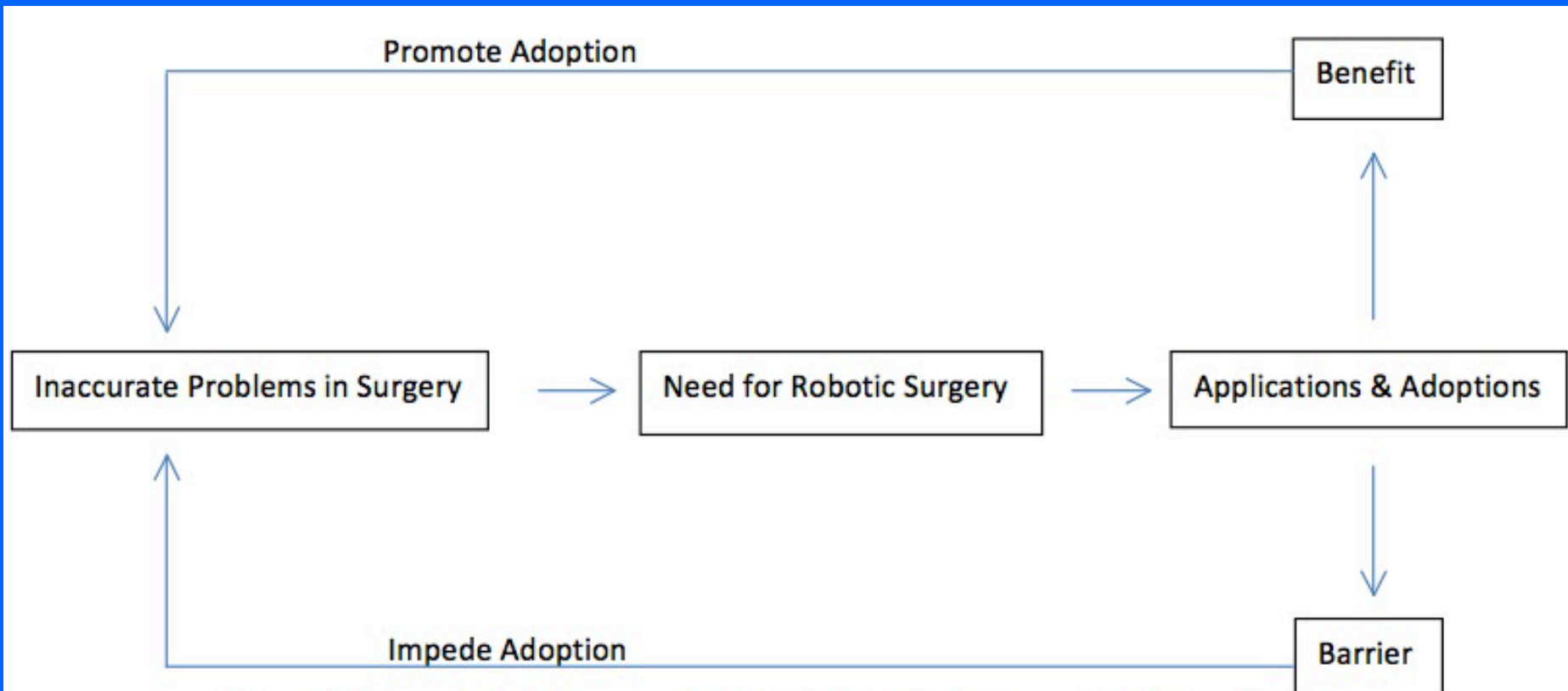


Figure 1: Conceptual Framework: Robotic Cardiac Surgery Technical Features
Source: Yao (2011)

Da Vinci Robot System



Da Vinci Robotic System

- Most popular robotic system with more than 500 installed in the U.S.
- Components: surgeon console, patient side car, and vision system.
- Robotic Arm: three dimensional endoscope and EndoWrist instruments
- Advantages: Seven degrees of freedom, three dimensional vision, instinctive movement of instruments

Da Vinci Robot System



Results

- Ability to manipulate instruments and tissues easier with increased degrees of freedom (7)
- Instrument manipulation more intuitive by eliminating fulcrum effect.
- 3-D view with depth perception greatly enhances vision
- Improved patient outcomes

Results

- **Robotic Surgical System:** initial cost \$1.2 million and yearly maintenance \$138,000.
- **Extended Operating Room Time:**
 1. 18% longer Mitral valve repair robotic 239 minutes vs. conventional 209 minutes.
 2. Laparoscopy robotic 97.1 minutes vs. traditional 82.1 minutes

Discussion

Benefits:

- Cardiac surgery robots have a positive influence on how well surgeons perform
- These robots make the surgeons job easier and produce better patient outcomes
- Cardiac surgery robots can improve and perform better as technology advances

Discussion

Barriers:

- Cost
- Takes longer time
- Fewer surgeries per day
- Longer to train and educate

Discussion

- Cost
 - da Vinci robot is an initial \$1.2 million investment
 - Approximately \$100,000 yearly maintenance fee
 - \$1500 per patient fee for disposable robotic equipment
 - Institutions should perform individualized cost/benefit analysis to avoid “Gizmo Idolatry”

Limitations

- Research bias
- Select few databases used
- Search strategy
- Publication bias

Discussion

- Cost is the main component impeding the adoption of cardiac surgery robots
- Implementation would benefit hospitals, physicians, and patients
- Cardiac surgery robots should be the new standard of practice

Discussion

- Da Vinci cardiac procedure ranks superior in all functional outcomes reviewed.
 - Improved precision and accuracy
- Major drawbacks: Cost & Steep Learning Curve
- More experimental studies are needed to validate the positive benefits of the da Vinci cardiac surgery.

Implications

- Surgical robots have the potential to provide surgical care in underserved areas
- Robotic surgery can provide surgical care to patients that do not have direct access to a surgeon

Questions?

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