



Insights

Autonomy in Surgery

Robotic arms paving the way to digital surgery



Advancements in medical science in the last few decades have been tremendous, from development of faster diagnosis to newer ways to treat and cure diseases, new drugs, minimal invasive surgeries using laparoscopy and robotic arms, and insights from historical data, we have come a long way. Technology innovations have played a big role in this progression. Autonomy is the mantra of where the future is taking us. Today, healthcare has been piloted by providers and care givers. The time is not far where providers will become copilots and pave way to autonomy in few decades, be it diagnosis, treatment, surgeries, or recovery. Before we dive into the future of surgeries it's important to understand the past and key forces that are driving it today.

The journey so far and the road ahead

Surgery 1.0 — Traditional open surgeries using jigs etc. and heavily skill dependent

Surgery 3.0 — Today as we stand, use of robotic arms, navigational tools and software are becoming primary occupants of surgery rooms

Surgery 2.0 — Saw adoption of laparoscopy which brought minimal invasive nature and introduction of costly med tech

Surgery 4.0 — The future or 'Digital Strategy' will be a union of the best from the past and an ecosystem primarily supported by holistic care for patients and other factors like personalization, insights from data, and interoperability etc.

Key Drivers

1

Consumers are fueled by consumerization with expectations which needs to be at par with retail or banking sector.

2

Connected ecosystem backed by care outcomes continues to be a major factor in healthcare. Finally, when it comes to surgery, patients appreciate access to right information for apt decision making.

3

Providers and health systems are constantly striving to provide better customer experience, backed by Nextgen care. Leveraging technology innovations has been a constant endeavor and at the same time optimizing the cost.

The surgical façade, as it stands currently (robotic arms), has mostly been dominated by health systems, providers, and med tech companies. Patients have minimal say, except to pick surgeon / hospital, which is mostly based on their experience with similar cases in family or friends.

Trends by Numbers

As per NCBI, at least **4,000** surgical errors occur in the United States each year.

1

As per Centers for Disease Control and Prevention, **1.7 million** Americans develop hospital-acquired infections (HAIs) each year. Use of robotics can provide faster recovery times and fewer chances of infections & complications.

2

As per AAMC, there will be shortage of **65K** plus physicians by 2033 in various streams including primary care and surgical specialists. Leveraging robotics for sure will free up surgeon time and help create better efficiencies.

3

The global market for surgical robots by 2026 will be **\$9.6B**, up from \$4.4B in 2020 at 11.4% CAGR (2021-26)*.

4

Global knee replacement market by 2026, will be \$8B, up from \$6.5B in 2021 at 4.1% CAGR*.

5

With this huge opportunity, and in the journey toward **Digital Surgery**, we are at a juncture where the robotics arm plays a major role and will pave the path for surgery 4.0.

*Research & Markets (2021) and Mordor Intelligence (2020)

Robotics in Surgery / Health Systems and Key Players

1\ **Surgical Assistants:** Perform operations, typically minimally invasive procedures etc.

- a\ Stryker (Mako)
- b\ Medtronic (Mazor X Stealth)
- c\ Johnson & Johnson's (DePuy Synthes Velys)
- d\ Zimmer Biomet (Rosa)
- e\ Smith+Nephew (Cori / Navio)

2\ **Rehabilitation Robots:** Assist patients in post-surgery rehabilitation

- a\ Darwin (Georgia Tech)
- b\ Cyberdyne's HAL

3\ **Medical Transportation Robots:** Supply medications, consumables and meals etc.

- a\ TUG (Aethon Inc.)

4\ **Sanitation and Disinfection Robots:** Clean and disinfect rooms & surfaces

- a\ Xenex

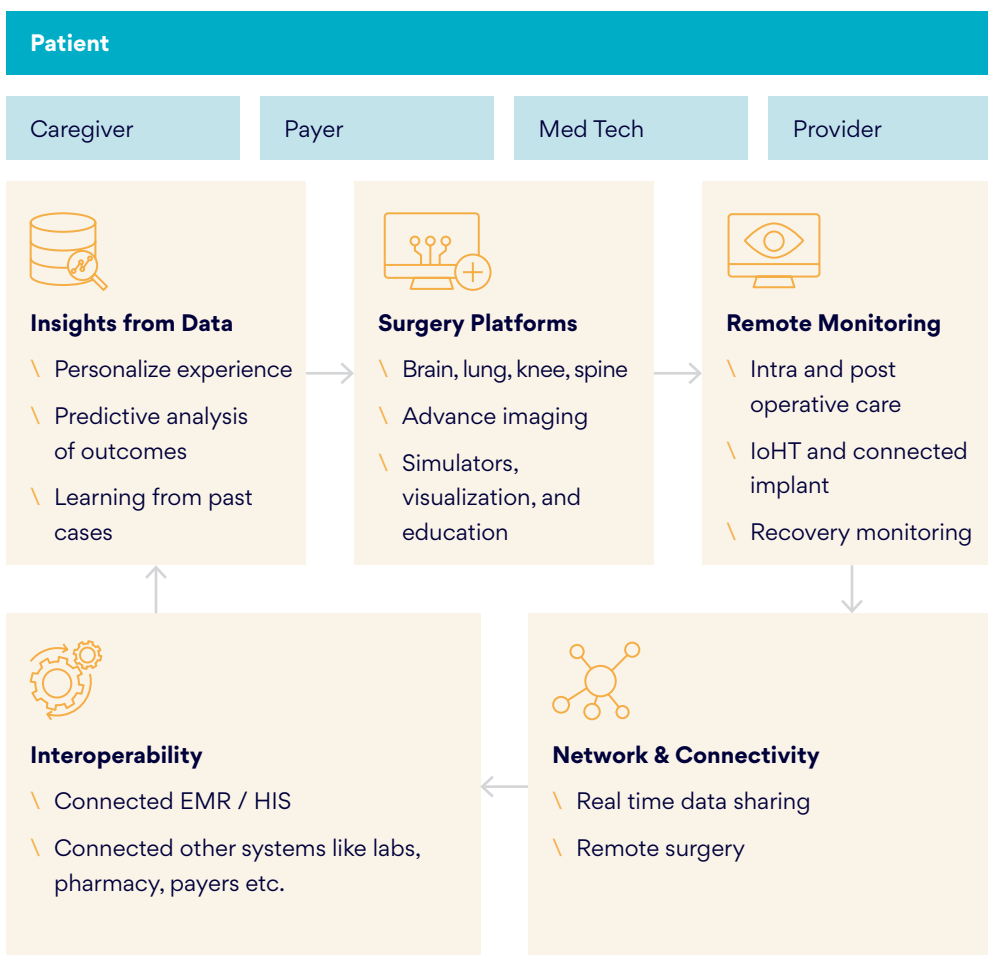
5\ Others like prescription dispensing (Omniceil), cyber knife (Accuray) etc.

Digital Surgery Ecosystem

For the digital surgery ecosystem, next decade will be mostly where the robotics platforms will evolve to support new point solutions across therapeutic areas and full spectrum (lung, trauma, brain, ortho etc.). This will take the robots from assistive care to fully automated support and some autonomy.

At the same time, the ecosystem backed by technology will integrate insights and predictive analysis from historic data and provide seamless connectivity to health systems (labs, payers, providers, EMR / HIS etc.). Remote monitoring and connected ecosystem will become a reality with connected implants and IoHT.

Digital Surgery



Key Technologies

- AI / ML Data Insights
- IoHT
- AR / VR
- 5G & Cloud
- Edge Computing
- Advanced Instrumentation
- Advanced Imaging
- API Ecosystem

Figure 1: Digital Surgery Ecosystem

Primarily digital surgery will be backed by advanced imaging, 3D printing, NLP, IoHT, and advanced instrumentation. AI / ML and deep insights will support patient use cases from personalization to predictive care outcomes. Considering the remote

and connected setup, 5G and network stability will be key drivers. Finally, like any healthcare ecosystem, privacy and security will continue to be crucial in all aspects of care delivery.

Imperatives for Med Tech

No doubt that Med Tech companies are most to benefit from this transformation — Digital Surgery (4.0).

Below are some key journeys Med Tech companies need to drive:

- 1\ Pull themselves as backend players and start focusing on customers and payers as soon D2C (direct to customer) approach will be must to establish the real value they bring and can drive customer experience. Customers should be able to choose between med platforms in the market and not the hospital system, which is how it works today.
- 2\ Provide innovative pricing models, so providers and hospitals should not be burdened with heavy capex cost. Specially, ambulatory surgical centers (ASC) and alike will benefit from pay per use model where they pay based on usage and no initial setup cost.
- 3\ Platform SaaSification (SaaS / PaaS) would be a must to support distributed and newer payment models.
- 4\ Personalization of care via predictive decision making leveraging historic surgery data and advancement in robotics surgery like connected implants will create additional value and autonomy for care delivery.
- 5\ Even the surgeons and doctors will be required to shift focus to R&D to support the Med Tech in advancement on platforms to mimic what they do day to day.

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