Stroke Management
New Frontiers

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April 2018
The changing healthcare market

Macro Trends

Market Transformation

Consolidation
Building the critical mass

Industrialization
Doing more with less

Managing Health
Value-based healthcare

Market Trends

Demographic shift
Consumerism
Population growth
Rapid scientific progress
Staff shortage
Shift to value-based reimbursement
Growing chronic disease burden
Increasing cost pressure
The changing healthcare market creates multiple challenges on your end ...

**Clinical**
- Extend Clinical Capabilities
- Improve Quality of Care
- Standardize Care

**Operational**
- Increase Efficiency
- Attract, Retain, Develop Workforce

**Financial**
- Manage Reputation
- Improve Profitability
- Stay Competitive
- Reduce Risk & Act Compliant
- Balance Fix vs. Variables
Our focus is to enable you to achieve better outcomes at lower costs.
As your partner, we offer expertise, innovation and resources for your specific needs.

- > 70% of critical clinical decisions are influenced by the type of technology we provide\(^1\)
- 1,474 invention disclosures in 2015
- > 45,000 employees
- Access for 1.08 bn people in developing countries\(^2\)
- ~ €13 bn revenue
- SiemensHealthineers
- > €1 bn R&D spent
- > €1 bn revenue
- 73 countries with direct presence
- World market leader in most businesses
- Biggest supplier of medtech infrastructure
- > 209,000 patients every hour\(^2\)

1 AdvaMedDX, "A Policy Primer on Diagnostics", June 2011, page 3
2 Siemens AG, "Sustainable healthcare strategy - Indicators in fiscal 2014", page 3-4

Siemens Healthcare, Advanced Therapies
Our focus is to enable you to achieve better outcomes at lower costs

Medical Imaging helps optimize procedures for individual cases, which may result in:
- Fewer complications
- Fewer reoperations
- Shorter hospital stays
- New medical paths

Diagnostic Imaging
Image-guided interventional therapy
Follow-up

Spending for conventional treatment
Potential spending – optimal integration of diagnostics into therapy
Image-Guided Interventional Therapy
Clinical Trends

Transaortic Valve Implantation
- TAVI

Endovascular Aortic Repair
- EVAR

Transarterial Chemoembolization
- TACE

Mechanical Thrombectomy
- STROKE

Increase of TAVI procedures in Germany in 6 years from 637 to 13,264

Increase of EVAR procedures in the US in 9 years from 11,028 to 50,220

Compound annual growth rate for embolization procedures

Expected rise of mechanical thrombectomy in the US from 2015 to 2020

Image-Guided Interventional Therapy
Clinical Trends

Transaortic Valve Implantation
Endovascular Aortic Repair
Transarterial Chemoembolization
Mechanical Thrombectomy

TAVI
EVAR
TACE
STROKE

~20×
~4.5×
+10.1%
+30.3%

Increase of TAVI procedures in Germany in 6 years from 637 to 13,264
Increase of EVAR procedures in the US in 9 years from 11,028 to 50,220
Compound annual growth rate for embolization procedures
Expected rise of mechanical thrombectomy in the US from 2015 to 2020


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Stroke management
Solutions for improved patient outcome
Stroke Numbers in Italy

3rd leading death cause\(^1\)

2nd leading dementia cause\(^1\)

1st leading disability cause\(^1\)

1. Source: S.I.S.S. (Società Italiana per lo Studio dello Stroke)
Stroke
Cerebral Infarction

Hemorrhagic Stroke (13%)¹

Ischemic Stroke (87%)¹

1. http://www.salute.gov.it
Stroke
Time is brain

• Acute Care

• In acute ischemic stroke, in each minute, 1.9 million neurons, 14 billion synapses and 12 km of myelinated fibers are destroyed¹

• “Time is brain”: 30 minutes earlier treatment results in 10% better outcomes²

CAGR: 30.3%

Expected rise of mechanical thrombectomy will trigger increased demand of endovascular devices

2. Source: The MedTech Strategist
Stroke

The standard workflow

1. Model of Stroke Care; Department of Health; State of Western Australia (2012)
Stroke

Endovascular treatment superior to i.v. lysis alone

Trials show

- Improved patient outcome
- Lower mortality rate
- Shorter hospital stay

EXTEND-IA

et al

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Stroke

The new standard workflow

1. Neuro News (December 2015)
Stroke
Hub-and-spoke stroke network\(^1\)
Stroke
Hub center
Stroke
Endovascular treatment superior to i.v. lysis alone

DAWN TRIAL

*Thrombectomy 6 to 24 Hours after Stroke*

**KEY POINTS FROM**

*Thrombectomy 6 to 24 Hours after Stroke with a Mismatch between Deficit and Infarct*

by R.G. Nogueira et al.

JANUARY 4, 2018

![Graph showing utility-weighted modified Rankin scale](image)

Trials show

![Graph showing functional independence](image)
Stroke
Minimum door-to-groin time is key

Exclude bleeding:
Ischemic or hemorrhagic?

Locate clot
Salvageable tissue?

Reduce door-to-groin time by answering 2 key questions
Stroke
Salvageable tissue

“To treat or not to treat?” – In other words: “Is there something left to rescue?”

EARLY

LATE

Non-treated

Treated

Tissue at risk
Infarct core
Stroke

The Siemens options: One-stop-shop approach

Standard Workflow (Sequential)
Stroke

The Siemens options: One-stop-shop approach

Standard Workflow (Sequential)

Innovative Workflow on one modality (Integrated)

30 minutes saved = 10% better chance for good outcome (mRS ≤ 2)
(The MedTech Strategist)
To treat or not to treat?

Hypoperfusion in CBV

“Core infarct”

syngo DynaPBV Neuro

One angio-scan (60 cc iv-contrast) to get all information

Native syngo DynaCT

Bleeding detection

Clot location and collaterals

→ “Tissue at risk”

Hypoperfusion in CBV

→ “Core infarct”

To treat or not to treat?

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(Left image: courtesy of Prof. Skalej, Neuroradiology Magdeburg)
(Middle and right Image: courtesy of Prof. Dörfler and Dr. Struffert, Neuroradiology, Erlangen)
Bleeding detection: One step ahead with Artis Q
Comparison of DynaCT and CT

Due to:
• Powerful x-Ray tube (flat emitter tech.) +
• 16 bit detector +
• 16 bit Imaging chain +
• dedicated cone-beam reconstruction (75 frame/sec. at 2Kx2k)
this IQ can be achieved

Image courtesy of Prof. Skalej, Neuroradiology, Magdeburg
syngo DynaPBV Neuro
One angio-scan (60cc iv-contrast) to get all information

To treat or not to treat?

Clot location and collaterals → “Tissue at risk”
Hypoperfusion in CBV → “Core infarct”

Image courtesy of Prof. Dörfler and Dr. Struffert, Neuroradiology, Erlangen
Example workflow of left MCA occlusion
Comparison with “gold standard”: CT-Perfusion

Size and location of “tissue at risk” + collateral status are known!

Size and location of “infarct core” is known!

Image courtesy of Prof. Dörfler and Dr. Struffert, Neuroradiology, Erlangen
Example workflow of left MCA occlusion
Comparison with “gold standard”: CT-Perfusion

- Size and location of “tissue at risk” + collateral status are known!
- Size and location of “infarct core” is known!

CT

![CT](image)

CBF

![CBF](image)

CBV

![CBV](image)

Artis Q

DynaCT-Angio

![DynaCT-Angio](image)

DynaPBV Neuro

![DynaPBV Neuro](image)

Image courtesy of Prof. Dörfler and Dr. Struffert, Neuroradiology, Erlangen

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CLEARmap: Smooth workflow in Roadmap
Optimized image quality by individual windowing

Individual Windowing of tools and vessels:
- Uncompromised visibility
- Optimized for micro devices

Image courtesy of Prof. Chapot, Essen, Germany
CLEARmatch: Next generation real-time pixel shift
Optimized Image-quality in DSA and Roadmap

Compensating for motion with pixel-shift in six dimensions

w/o CLEARmatch  w/CLEARmatch

Image courtesy of Prof. Chapot, Essen, Germany
**Stroke**

**The innovative workflow**

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**Today’s standard**

1. **Arrival at hospital**
2. **Neurological exam**
3. **CT**
4. **CT Perfusion**
5. **ER**
6. **Angio suite, treatment**
7. **Arrival at hospital**
8. **Neurological exam**
9. **MR**
10. **MR Perfusion**
11. **Angio suite, treatment**

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1. **Source for left diagram:** Today’s average times from different stroke process optimized hospitals and trials (ESCAPE, SWIFT-PRIME)
2. **Source for right diagram:** Results from UM Goettingen (GER), Dr. Psychogios et al.

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**30 minutes saved =**

- **10% better chance for good outcome (mRS ≤ 2)**
  
  *(The MedTech Strategist)*

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**Save one hour**

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**1.** Source for left diagram: Today’s average times from different stroke process optimized hospitals and trials (ESCAPE, SWIFT-PRIME)

Source for right diagram: Results from UM Goettingen (GER), Dr. Psychogios et al.
Performance and Precision

- **Performance** with a revolutionary all-new X-ray Imaging chain

- New applications for more **precise** and personalized therapy
GIGALIX X-ray Tube
Focused power

Optimized focal spots
• The flat emitter technology allows focusing the power on **smaller, square** focal spot sizes
• Image-quality-relevant square focal spot sizes: 0.3/0.4/0.7 Angio tube

Excellent spatial resolution in any direction
GIGALIX X-ray Tube
Focused power

Conventional Filament Emitter
- Large focal spot
- Stent
- Detector

Flat Emitter
- Small focal spot
- Stent
- Detector

Not drawn to scale
Large HDR Detector
High dynamic range and dose efficiency

- 16-bit analog-digital conversion
- Higher Detective Quantum Efficiency (77%)
- Actively cooled

- The large detector delivers images with high dynamic range
- Combined with the Gigalix tube, this results in better soft tissue resolution in 3D Imaging (for bleeding detection/exclusion)
The Artis Q Family
Visionary Intervention

Powerful GIGALIX X-ray tube

High Dynamic Range Detector

True 16 bit Imaging pipeline in 3D
syngo DynaCT
Dedicated cone beam reconstruction

Optimized CBCT images

- **CLEARPulse**: the new grid-pulsed flat emitter technology allows short pulses up to 75 frame/sec.
- **syngo DynaCT Micro**: higher resolution by using every single pixel (2k x 2k)

~40% more spatial resolution, enhancing the smallest details

Hypo density, also effecting gray matter in nearby slices

=> Early infarct sign of stroke!

Hypo density, also effecting gray matter in nearby slices

=> Early infarct sign of stroke!

Courtesy: Prof. H. Oishi, Department of Neurosurgery, Juntendo University School of Medicine, Japan
syngo DynaCT
Dedicated cone beam reconstruction

Optimized CBCT images
- **CLEARPulse**: the new grid-pulsed flat emitter technology allows short pulses up to 75 frame/sec.
- **syngo DynaCT Micro**: higher resolution by using every single pixel (2k x 2k)
- **syngo DynaCT Smart**: reduces metal artifacts from metallic implants (coils, clips, etc...)

Allowing physicians to see the unseen

Courtesy: Prof. Hidenori Oishi, MD, Juntendo University School of Medicine, Tokyo, Japan
syngo DynaCT
Dedicated cone beam reconstruction

Optimized CBCT images

- **CLEARPulse**: the new grid-pulsed flat emitter technology allows short pulses up to 75 frame/sec.
- **syngo DynaCT Micro**: higher resolution by using every single pixel (2k x 2k)
- **syngo DynaCT Smart**: reduces metal artifacts from metallic implants (coils, clips, etc...)
- **syngo DynaPBV Neuro**: visualizes the blood volume distribution of the whole brain in 3D

Evaluate the infarct core
(CBV maps equivalent)

*Courtesy: Prof. Schroth/Dr. Gralla, Inselspital, Universitätsspital Bern, Switzerland (up: pre-recanalization images; down: post-recanalization images)*
The Artis Q Family
Visionary Intervention

- Biplane
- Robot
- Ceiling-mounted
- Floor-mounted
Figure 1: The detector entrance dose for standard head DSA examinations has decreased significantly from AXIOM Artis (2001) to Artis zee and Artis Q (2013). Siemens uses 22 cm Field of View (FoV) as a reference format for standardized dose display. At this format, the dose went down from 3600 nGy/frame to only 540 nGy/frame.

1 In this document "dose" means air kerma.
The Artis Q Family
PURE® Interface: Adding Smooth to Smart

Smooth interaction
Save time during procedures.
Fewer steps. More efficiency.

Smart performance
Expand your capabilities.
Stroke

The Siemens options: One-stop-shop approach

Standard Workflow (Sequential)

Innovative Workflow on one modality (Integrated)

Innovative Workflow on more combined modalities (Integrated)

30 minutes saved = 10% better chance for good outcome (mRS ≤ 2)
(The MedTech Strategist)

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(The MedTech Strategist)

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Nexaris Angio-CT for stroke management

Artis Q biplane with PURE

SOMATOM Definition Edge Sliding Gantry CT
Nexaris Angio-CT for stroke management

- System combination sharing one table without Patient transfer
- Optimized, easier and faster workflow resulting in better outcomes
- Cost savings through reduced workflow time and better neurological outcomes
- High-end care for centers of excellence
- Establish the institution as an attractive employer for highly specialized physicians
Nexaris Angio-CT for stroke management

Everything in one room
Nexaris Angio-CT for stroke management

- A two rooms installation is optimal for maximal system utilization: both systems, angio and CT scanner, can be used independently, 24/7

- Optimize your financial performance with a small-footprint system that can be set up according to your specifications

- Profit from a flexible two-rooms solution that optimally uses space and resources, e.g. in the emergency department
Nexaris Angio-CT for a multi-disciplinary context

DEA

NEURO

VASCULAR

SURGERY

CARDIO
Nexaris Angio-CT-MR for a multi-disciplinary context

Siemens Healthcare, Advanced Therapies
## Nexaris Angio-CT-MR for a multi-disciplinary context

### Angiography
- Visualization of small vascular structures and needle/catheter guidance:
  - Fluoroscopy
  - Digital Subtraction Angiography (DSA)
  - 3D Imaging
  - Needle guidance
  - Image fusion

### MRI
- Enhanced soft-tissue information without ionizing radiation:
  - Soft-tissue Imaging
  - Perfusion Imaging
  - Diffusion-weighted Imaging
  - Imaging to support ablation verification
  - Vascular assessment

### Sliding gantry CT
- Fast and comprehensive image information in time-critical situations:
  - High- and low-contrast Imaging
  - Skeletal Imaging
  - CT angiography
  - CT needle guidance
  - Perfusion Imaging
Nexaris Angio-CT-MR for a multi-disciplinary context
# Stroke & HTA
(Health Technology Assessment)

<table>
<thead>
<tr>
<th>Diagnosi affezionata</th>
<th>DDS collegate all’uso della tecnologia</th>
<th>Graduali (casi specifichissimi della prestazione) (cicli lunghi, più complicati)</th>
</tr>
</thead>
</table>

### 2.2. RISPETTI ALLE TECNICHE DIURNE PER IL PROCESSO ASSISTENZIALE DESCRITTO
LA TECNOLOGIA INDOPIA

1. Influenza tecnica (specificare)

2. Emissione unità tecnica (specificare)

3. Assicurazione unità tecnica (specificare)

4. Assicurazione unità tecnica (specificare)

5. Assicurazione unità tecnica (specificare)

6. Assicurazione unità tecnica (specificare)

### 2.3. LA TECNOLOGIA PROPORZIONE SECONDO LA RISOLUZIONE DI SICUREZZA E EFFICIenze NESSUNI ALTRI DI LAVORO

<table>
<thead>
<tr>
<th>SI</th>
<th>NO</th>
</tr>
</thead>
<tbody>
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</table>

Se SI descrivere in quale modo:

### 2.4. PROGETTO EXPERIMENTALE O/CLINICHE LOCALI

<table>
<thead>
<tr>
<th>Località</th>
<th>Codice C.A.P.</th>
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</table>

**1. IMPACT CLINICO - ORGANIZZATIVO - ECONOMICO**

<table>
<thead>
<tr>
<th>IMPACT CLINICO</th>
<th>ORGANIZZATIVO</th>
<th>ECONOMICO</th>
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Now’s our time to inspire the future of healthcare together