Whitepaper

Process innovations with SOMATOM Force

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Introduction

At the top of our Dual Source CT portfolio, SOMATOM Force enables a new level of adaptability to patients, and achieves superb image quality and clinical outcomes. It allows you to examine patients without having to control their heart rate, with no need for them to hold their breath, and with the lowest possible dose of contrast media. You can make clearly quantified therapy evaluations with dose-neutral Dual Energy. Automated technologies support safe, standardized, and highly effective workflows – allowing for appropriate dose and reproducible precision from the smallest to the tallest patients. What is more, it connects you to the future through an ever-growing expert community and VIP access to our advanced research environment.

With SOMATOM Force, Siemens Healthineers will become a partner in driving the future of healthcare by rethinking the way you work. Rethinking the way medical processes are organized with this scanner is the outcome of a case study with existing SOMATOM Force users. The users interviewed came from Germany and Switzerland, and represented different care levels and specialties. They included staff from university hospitals and outpatient centers, and ranged from clinical employees (radiologists) to managers (e.g., CEOs). This provided a 360-degree view of hospital processes involving a SOMATOM Force. The results of these interviews highlight four new ways to approach various clinical areas: SOMATOM Force is helping to change medical pathways, speed up the scanning process, and replace invasive procedures. It could even have indirect effects such as increasing productivity in the operating room (OR). In other words, SOMATOM Force has the potential to help CT staff work more efficiently, for instance, and could therefore help to reduce the time to diagnosis.

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High-end CT imaging and its impact on radiology departments, hospitals and the society

The number of CT scanners available in hospitals worldwide has increased enormously over the past 40 years.[1] In addition, the technology has changed tremendously since the early days of CT scanning. Nowadays, we can rethink and restructure our medical processes in a way that simply was not possible before, thanks to the support that technology offers in clinical routine. We are in a position to potentially streamline imaging and support medical staff to provide patients with the best possible care. Excellent image quality, low dose, and revolutionary approaches deliver higher diagnostic confidence for better, more accurate, and faster treatments. Siemens Healthineers offers technology which is two steps ahead: SOMATOM Force is a high-end Dual Source CT scanner that fulfills all your clinical needs. As one customer put it when explaining his hospital's choice of new scanner: "We asked the clinical departments which examinations we should be able to perform (...). When the answers came back, we could see that it was pretty much everything. So we bought SOMATOM Force."[2]

However, high-end CT scanners come of course with financial investment for purchase and service and hospitals obviously have to keep a close eye on their spending. Therefore, potential users need to see proof that the higher investment pays off. Customers must also think beyond dose and contrast savings. They need to consider their clinical pathways and how this kind of system can change their medical processes for the better. For example, personnel costs in most medical sectors account for between one third and half of all hospital spending.[3] Therefore, staffing is a high valuable but also cost-effective factor in the hospital.

The clinical and imaging quality of SOMATOM Force has been proven in various studies.[4] It is therefore now a question of showing how SOMATOM Force can help to either reduce overall costs or increase revenue by changing clinical pathways (Figure 1).

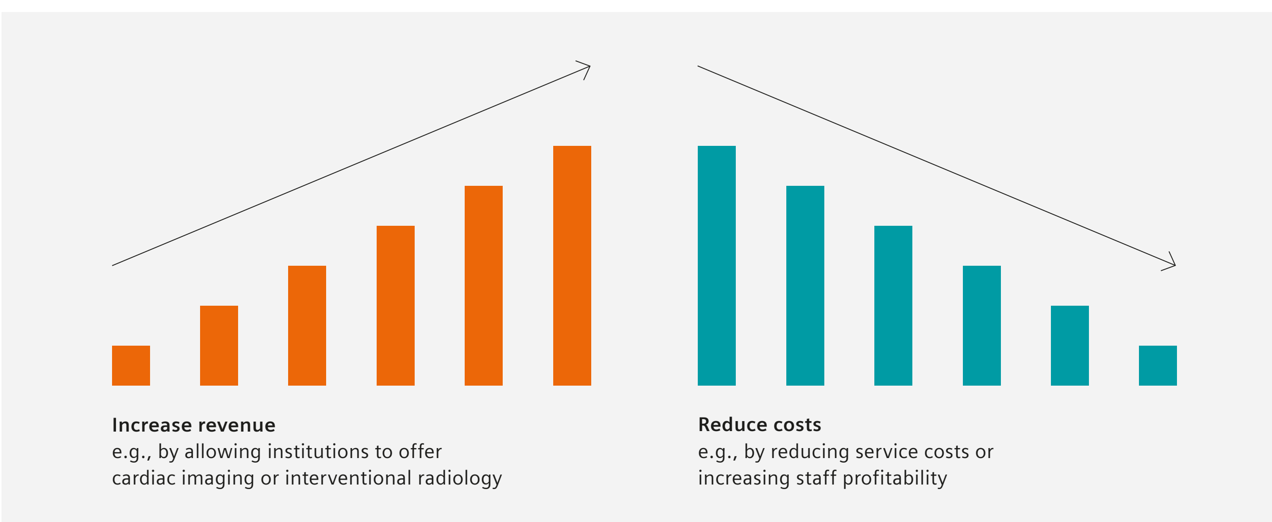

Figure 1:
How SOMATOM Force could help to increase revenue or reduce costs

From a reimbursement perspective, the two strategies shown above will be closely linked to the healthcare financing system in the individual countries. Due to local differences in those aspects, this white paper will focus on sample cases which then can be adapted to fit a given country's healthcare system. Most countries in the world, however, are financed through diagnosis-related groups. These are directly related to three key factors:

- Main diagnosis and secondary diagnoses
- Length of stay
- Procedures

If the diagnosis from a CT scan is more accurate, the subsequent treatment can be tailored to the patient's specific needs and potentially reduce the length of stay.[5] In addition, it is easier to perform the CT scan, the medical staff is supported in their daily work, and costs could potentially be reduced as staff would be available for other tasks.

To collect concrete examples that demonstrate this, a Siemens Healthineers team visited ten hospitals (mainly in Europe) which had recently installed a SOMATOM Force. The team interviewed staff at the hospitals about the main ways in which the scanners had changed their daily routine. As a second step, the team assessed key areas in terms of clinical, operational, and financial benefits.

How SOMATOM Force can make a difference

The case study identified four key areas in which SOMATOM Force changed the way the hospitals think and work. Three of these directly affect existing diagnostic process steps, and one has an indirect effect on the complete diagnostic and therapeutic patient pathway (Figure 2).

- Direct impact on diagnostic process (orange)
  - Replacement of imaging modalities with one that delivers higher diagnostic support
  - Elimination of process steps within the CT procedure itself
  - Replacement of invasive imaging with noninvasive approaches
- Indirect impact on the therapy process (petrol)
  - Improvement of therapy planning procedures

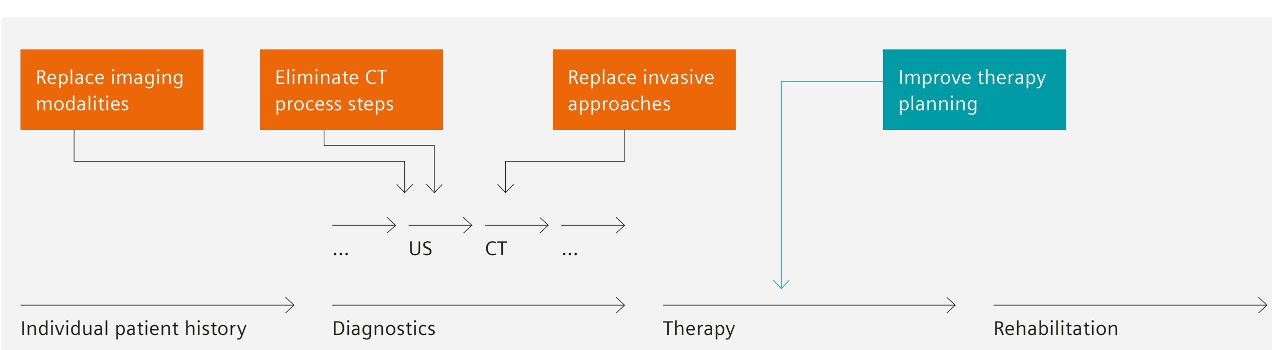

Figure 2:
Areas of potential direct (orange) and indirect (petrol) improvements in medical pathways with SOMATOM Force.

Four process innovations

1. Replacement of imaging modalities with one that delivers higher diagnostic support

Appendicitis is the most common acute abdominal condition that requires surgery in both adults and children.[6] In most countries, the current gold standard in diagnosing acute appendicitis (AA) is ultrasound (US).

Compared to CT, ultrasound is significantly less sensitive,[6-7] but of course involves no radiation. Therefore, CT is often used if ultrasound fails to determine the pathology in the first instance (Figure 3).

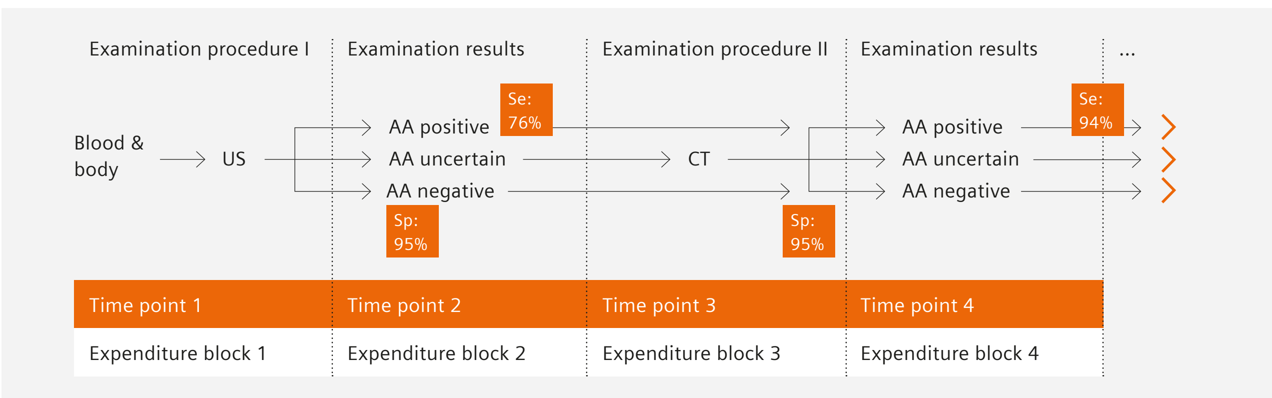

Figure 3:
Current appendicitis diagnostic process showing time points (orange) and expenditure blocks (white) with normal CT[6-7].

SOMATOM Force and its high-pitch method mean that an abdominal scan can be performed with dose levels low enough to make CT the preferred method. CT has a higher sensitivity (Se) and specificity (Sp) than ultrasound. In addition, the superior image quality of the high-pitch method of the SOMATOM Force allows users to accurately visualize abnormalities and therefore make concrete diagnoses.[6-7] This affects the overall patient pathway by reducing subsequent imaging steps, which in turn has an impact on the expenditure and time involved in these examinations (Figure 4).

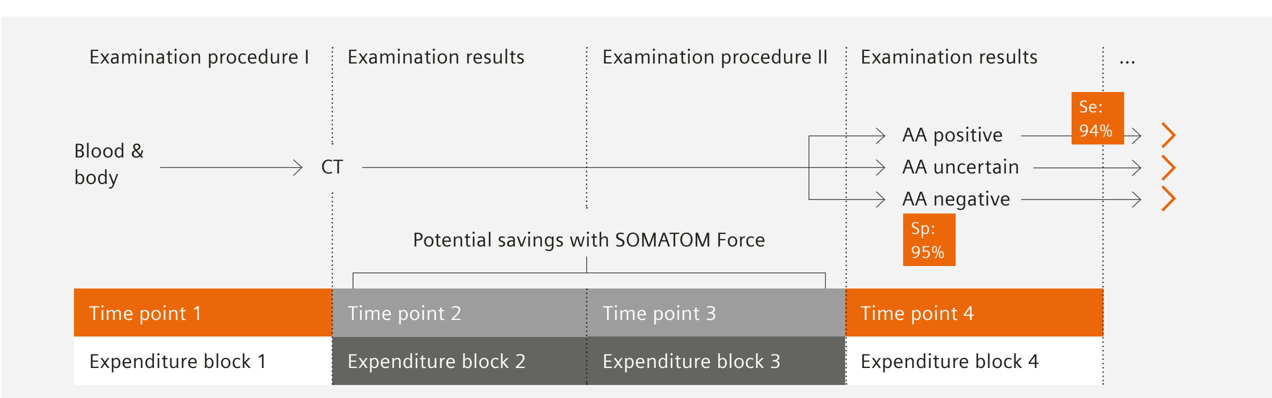

Figure 4:
Appendicitis diagnostic process using CT as the first modality; the chart shows the time points (light grey) and expenditure blocks (dark grey) that can potentially be saved with SOMATOM Force.

Potential cost savings stem from several changes in the process of assessing acute appendicitis (Table 1):

	Staff (medical/physicians)	Room occupation	Patient safety and comfort
Process outcome	• Examination takes less time • Fewer challenges for inexperienced staff (i.e., during night shifts)	• Potential for higher throughput due to faster imaging process • Potential for reduced OR occupation due to fewer unnecessary surgeries	• Potential for fewer unnecessary surgeries • Potential for fewer readmissions and repeat surgeries
Financial outcome	Potential for better patient outcomes at lower costs, or with higher productivity		

Table 1:
Areas that potentially benefit from process innovations with SOMATOM Force: Changing imaging modalities to diagnose acute appendicitis (AA)

2. Elimination of time-consuming process steps within the CT imaging workflow

Pediatric imaging involves a number of obstacles. In addition to the need for low doses, it can be hard for children to hold their breath or stay still in one position. Therefore, sedation is often used in pediatric CT. However, this has several drawbacks concerning patient health and staff workflows. Anesthesia teams are in very high demand and therefore not always immediately available. Furthermore, the scanning room will be occupied for longer if the sedation is prepared and carried out there.

Lell et al. (2011) found that sedation is responsible for up to 15 minutes of additional examination time. With SOMATOM Force, it is possible to scan pediatric patients in a high-pitch mode without sedation.[8]

As shown in Table 2, eliminating the need for sedation means that both the anesthesiologist and the nurse are occupied for less time. With sedation, they have to be present during the CT scanning process, whereas without it, they can move on to work with another patient. As a result, eliminating sedation for pediatrics could help to reduce examination time, staff occupation levels, and the risk to patients due to the sedation – while at the same time increasing patient comfort.

In the context of pediatrics, this means children and parents are more relaxed, and children are not exposed to the side effects of sedation.[9] Along with the medical advantages, removing the need for sedation offers potential for several operational and financial benefits (Table 2).

Process steps (patient)		Preliminary	Admission	Waiting time	Preparation	CT scan	After-care	Discharge
With sedation								
	Nurse				X	X	X	
Role	Radiographer					X		
	Anesthesiologist	X			X	X	X	
Without sedation								
	Nurse				X			
Role	Radiographer					X		
	Anesthesiologist							

Table 2:
Overview of staff occupation during each process step (x); sections highlighted in grey represent areas in which SOMATOM Force can potentially achieve savings

3. Replacement of invasive imaging with noninvasive approaches

Every year, cardiovascular diseases are the leading cause of death worldwide.[10] Almost 30 million people have been diagnosed with heart disease in the U.S. alone,[11] which costs the country about $200 billion each year.[12] To diagnose the sources of cardiovascular pain, and therefore identify the right treatment, invasive coronary angiography and coronary CT angiography (CTA) are two possible solutions. Both methods have their pros and cons. But invasive coronary angiography is not a purely diagnostic procedure. In four out of ten cases, an actual intervention in the coronary vessels is performed to treat the patient. This means, however, that the procedure is not used for treatment in more than half of the cases (six out of ten). Interventional procedures are more expensive, involve greater risk of complications, and require more radiation than non-interventional CT imaging.[13]

A number of papers, such as the one published by Dorenkamp et al. (2011), prove that patients with intermediate pretest probability are suitable for noninvasive CTA.[14] Furthermore, it has been shown that using new noninvasive measurements such as CT-derived fractional flow reserve (FFR_{CT}) for triaging cardiovascular disease patients could reduce invasive procedures by up to 50 %. The basis for being accepted for this service is a high-quality cCTA dataset. SOMATOM Force has achieved extremely high acceptance rates of 97–99 % in initial clinical routine.[15]

As mentioned above, noninvasive diagnostic methods may have an impact on several areas (Table 3):

	Staff (medical/physicians)	Room occupation	Patient safety and comfort
Process outcome	• Examination takes less time • Higher productivity in the cath lab	• Potential for higher throughput due to faster imaging • Potential for lower occupancy of coronary angiography theater	• Potential for fewer unnecessary repeat interventions • Potential for fewer readmissions and repeat interventions
Financial outcome	Potential financial savings due to increased patient safety and therefore reduced complication costs. Potential for higher patient throughput.		

Table 3:
Areas that may benefit from process innovations with SOMATOM Force: Replacing invasive imaging with noninvasive processes

4. Improvement of therapy planning procedures

As a high-end CT scanner, SOMATOM Force also has the potential to indirectly affect medical pathways. One example for this is presurgery planning for breast reconstructions using the DIEP-flap technology. For these procedures, surgeons must know the exact location of the main vessels so that they can achieve a stable blood supply for the new tissue. This can be done via ultrasound, although this only delivers a partially useable anatomical image. CT angiography has been shown to be a better choice for this type of planning, and is even more suitable if done with 4D imaging.[16] Shorter surgery times, fewer complications, higher flap success rates, and reduced lengths of stay are the key medical advantages (Table 4).[17]

	US		CT
Population	138 breast reconstructions		
Surgery time	395 min.	-82 min.	313 min.
Complication rate	25 %		20 %
Flap failures	1 complete die-off, 3 partial die-offs		–

Table 4:
Comparison of US and CT for planning DIEP-flap reconstructions[17]

The above mentioned medical advantages lead to some important operational and financial advantages. If you save time within the surgical procedure, the OR is occupied less and you can potentially increase the overall number of surgeries per day. The same applies to OR staff: If they can spend less time on one surgery, they are free to support another one sooner. In addition, the DIEP-flap reconstruction described above reduces overall complication rates. Complication rates are normally linked to longer hospital stays.

All the benefits that come from using SOMATOM Force in preprocedural planning and from introducing a new procedure may help hospitals to reduce their overall costs.

The scanner being included into the surgical planning process offers the potential for faster surgeries and therefore more surgeries per day, while also increasing patient safety and saving money through reduced complication rates and shorter lengths of stay.

To sum up, these process innovations can deliver a number of possible benefits: Higher staff productivity, lower OR occupancy, reduced lengths of stay, and reduced costs. SOMATOM Force does all of this while keeping dose at acceptable levels (Figure 5).[16]

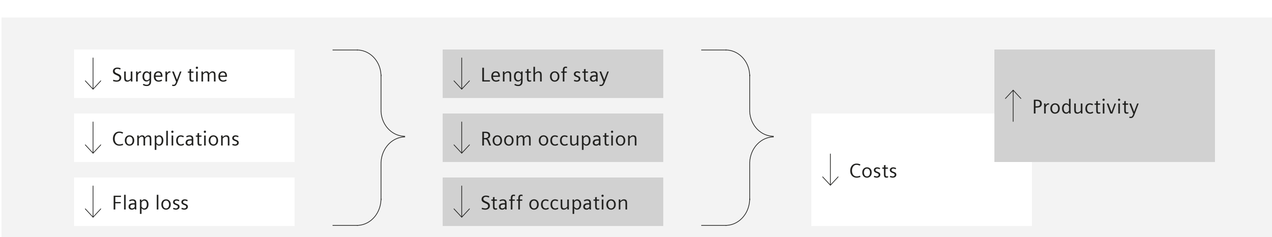

Figure 5:
Potential clinical, operational, and financial advantages of presurgery planning with SOMATOM Force

Conclusion

Siemens Healthineers' high-end Dual Source CT scanner SOMATOM Force may help to reduce costs by improving processes, and to boost financial performance by increasing productivity. In the long run, investing in high-end technology pays off if the scope goes beyond the CT procedure itself and incorporates the full medical pathway. While this white paper only shows the tip of the iceberg, it nonetheless demonstrates how SOMATOM Force could help to improve diagnostic and therapeutic planning processes by eliminating unnecessary diagnostic steps, and with that potentially speeding up the CT procedure itself, replacing invasive procedures, and improving surgical planning procedures, meaning producing indirect effects that could increase productivity also in therapy. Although every hospital and healthcare system is different, the outcome show that SOMATOM Force could change clinical pathways in every clinical setting and could also help to produce better outcomes at lower costs or increased revenue. Technical progress, of the kind that SOMATOM Force represents, not only potentially achieves faster, less harmful, and higher quality diagnostic imaging; it also benefits the imaging environment as a whole. It offers scope for restructuring processes to improve conditions for both staff and patients. In the end, it pays off – in the form of clinical, operational, and financial benefits.

Additional benefits from SOMATOM Force:

- Low kV imaging for all patients (especially beneficial for patients with renal insufficiency, as it could reduce the amount of contrast media required)
- Low-dose early detection with Siemens Healthineers' unique Tin Filter (e.g., in lung imaging)
- Dose-neutral Dual Energy imaging for clinical information that goes beyond morphology (by allowing you to characterize, quantify, and differentiate material)
- Turbo Flash mode for fast volume acquisition can freeze motion and reduce motion artifacts (this could help you avoid rescanning)
- High, hardware-driven temporal resolution for cardiac imaging in even the most challenging patients
- Patient-optimized dose with steps of 10 kV
- High spatial resolution to visualize even the smallest details
- FAST Integrated Workflow with FAST 3D Camera to expand precision medicine (or reduce unwarranted variations) with automated patient positioning

SOMATOM Force: Technical specifications

Detectors	2 x Stellar^{infinity} detectors with anti-scatter 3D collimator grid
X-ray tubes	2 x Vectron™ X-ray tubes
Number of acquired slices	384 (2 x 192) slices
Rotation time	up to 0.25 s*
Temporal resolution	up to 66 ms*
Generator power	240 kW (2 x 120 kW)
kV settings	70–150 kV in steps of 10 kV
Spatial resolution	0.24 mm*
Max. scan speed	737 mm/s* with Turbo Flash
Table load	up to 307 kg/676 lbs*
Gantry opening	78 cm

** Optional*

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Published by Siemens Healthcare GmbH · 9122 0520 online ·