



Kaleida Health's
Stroke Care Center at the Gates Vascular Institute
Acute Stroke Study – Phase One & Two

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Improving Stroke Patient Outcomes and Lowering Costs with Advanced Imaging Technology Under Healthcare Reform's Bundled Payments

Healthcare economic policies are changing rapidly since the Patient Protection and Affordable Care Act was passed in 2010. Today's healthcare system is transitioning from volume-based to value-, quality- and outcome-based. Today, there is a new focus on "bundled payments," which reimburses based on specific clinical episodes rather than fees for service, with a heavy focus on clinical episodes that result in the highest costs, such as stroke.

As the new bundled payment programs become a reality, stakeholders need to prove clinical utility, operational efficiency and financial performance of technology. The goal is to challenge clinicians to develop innovative solutions to contain the cost of service while continuing to deliver high-quality care. Toshiba's imaging technology can support healthcare institutions in achieving these goals by utilizing patient-focused imaging technology and a multidisciplinary, collaborative approach to treatment.

To quantify these benefits, Toshiba partnered with Kaleida Health's Stroke Care Center at the Gates Vascular Institute, formerly Kaleida Health's Stroke Care Center at Millard Fillmore Gates Circle Hospital, to conduct a multi-phase study analyzing stroke patient outcomes using Toshiba's Aquilion™ ONE CT system during diagnosis. The results clearly indicate that a collaborative approach to patient care

combined with the latest in imaging technology not only improves patient outcomes but also the bottom line.

Healthcare Economic Reform – Bundled Payments

Bundled payments provide one fixed payment for the treatment of a specific illness and combine the technical fee with the professional fee. The payment will cover services provided during an inpatient stay, as well as three days prior and 30 days post. Since this payment approach provides reimbursement on expected costs rather than fee-for-service, healthcare providers must work together closely to coordinate care.

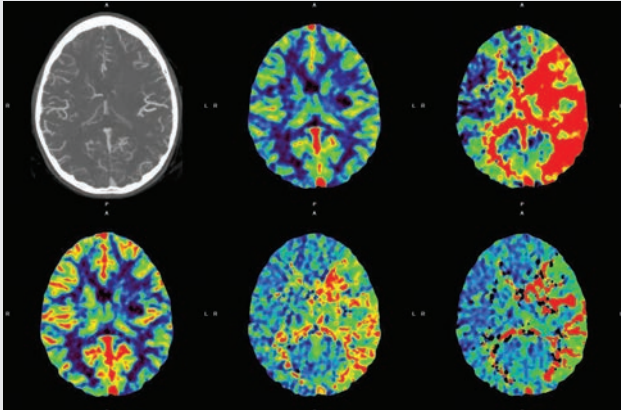
In addition to achieving greater efficiencies, this change is fueled by the anticipated growth in patients with health insurance due to healthcare reform legislation and the aging population. By 2030, there will be an estimated



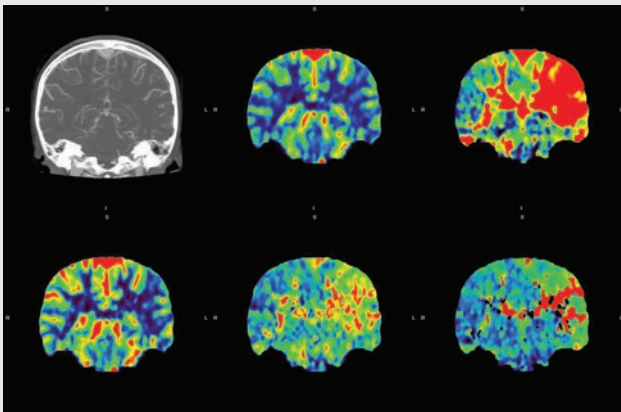
Kaleida Health's Stroke Care Center at the Gates Vascular Institute in Buffalo, N.Y., integrated Toshiba's state-of-the-art imaging systems, resulting in a multi-year improvement in both the patient and financial outcomes of stroke diagnosis.



The Stroke Care Center uses Toshiba's Aquilion ONE CT system in the diagnosis and treatment of stroke to decrease patient length of stay, improve discharge disposition and save more than \$2 million in costs.



Brain Perfusion axial maps demonstrating extensive perfusion abnormality in the left middle cerebral artery (MCA) territory.



Brain Perfusion coronal maps demonstrating extensive perfusion abnormality in the left middle cerebral artery (MCA) territory.

79 million Medicare beneficiaries, which is nearly double today's number. In 2014, an estimated 32 million people will join the insured as reform broadens the risk pool.

With the recent launch of accountable-care organizations (ACOs), pioneer ACOs are forming under the CMS Innovation Center and exploring the bundled payment approach. The CMS Innovation Center created the Bundled Payment initiative and will soon reveal the eight to ten medical conditions that CMS will target. This five-year pilot will test bundled payments for episodes of care and will be evaluated for improved quality, better access to care and reduced spending. There will be 60 days to comment, with delivery of a final rule expected later this year (in advance of the January 2013 program launch). These changes will challenge organizations to implement new rules while being even more efficient in how they provide care to patients.

More than ever, healthcare facilities will need to show the value of technology in delivering care.

Diagnosing Acute Stroke Within a Bundled Payment Model

Stroke accounts for approximately one in every 18 deaths in the United States, according to the American Heart Association, and is the fourth most common cause of death. Stroke is also the single most common cause of disability, and more than 780,000 strokes occur annually. With three-fourths of strokes occurring in people over 65 and it being such a widespread event, the cost of treating stroke is astronomical. The estimated annual cost of stroke is \$73 billion, including both healthcare-related costs and disability.

When evaluating the health issues to include in this new payment model, the bundled payment pilot program will target high-cost, high-volume episodes, such as stroke. Under the new payment model, if a patient has a stroke, everything done to diagnose and treat that condition is bundled together into one episode. The provider reimbursement is determined based on the expected costs for that episode of care. Individual provider payment schedules are eliminated and replaced with a care cooperative that disperses payments. In addition, centralized electronic health records will be accessible to all providers for better coordination of patient care. The goal is to reduce unnecessary services, duplicity of tests, and complications while compensating clinicians for improving the quality of care and reducing costs.

In stroke treatment, it is often said that “time is brain,” since the faster the clinician can detect decreased blood flow and determine a treatment plan, the better the patient's chance for survival and recovery. In addition to improving the quality of life, quickly diagnosing stroke has a greater economic impact under the bundled payment approach and an indirect benefit for long-term care insurance providers.

Today's top hospitals and stroke centers use the latest CT technology to perform perfusion imaging to assess neurological disorders to make treatment decisions. Depending on the specific case, patients may undergo intervention where imaging equipment, such as a cath lab, is used to treat and mitigate further damage.

This was not always the case, as limitations in the coverage volume of CT scans prevented perfusion imaging from being a truly effective tool in diagnosing stroke. However, developments in imaging technology, particularly Toshiba's Aquilion ONE, are enabling healthcare professionals to diagnose and treat stroke faster than ever before.

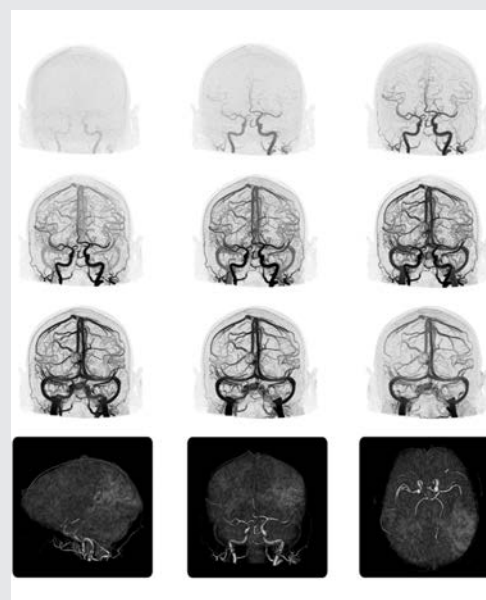
Kaleida Health's Stroke Care Center at the Gates Vascular Institute and Its Use of Toshiba's Imaging Technology

Toshiba understands that effectively transitioning to episode-based care requires more than just superior imaging equipment; it requires multidisciplinary cooperation and collaboration. Toshiba's technology offers solutions to help healthcare institutions prepare for episode-based care by effectively utilizing patient-focused imaging technology and a multidisciplinary collaborative treatment approach. Toshiba also offers a multidimensional knowledge base, dynamic customer interaction, and a robust support system of training and education to help medical teams transition and prosper within the new healthcare world.

One such example is Toshiba's partnership with Kaleida Health's Stroke Care Center (SCC) at the Gates Vascular Institute in Buffalo, N.Y., to diagnose acute stroke using the Aquilion ONE dynamic volume CT system. The SCC is a modern acute care center offering a full range of medical and surgical services, including world-class neurological and stroke care. The neuro-radiology department has integrated Toshiba's state-of-the-art training and imaging with an outstanding multidisciplinary team, comprehensive education and community outreach. The result has been a multi-year improvement in both patient and financial outcomes in the diagnosis of acute stroke.

Diagnosing Acute Stroke at Gates Stroke Center with 320-Detector Row CT Imaging

Toshiba and the SCC conducted a multi-year retrospective and prospective study on the effectiveness of utilizing the Aquilion ONE in the diagnosis and treatment of acute stroke. The goal of the non-controlled study was to measure the economic impact of 320-detector row, 640-slice CT on the diagnostic workup of patients presenting with symptoms of acute stroke and transient ischemic attack (TIA). It also tracked improvements over time. The SCC reviewed the patient diagnostic workup for stroke patients and analyzed



Dynamic CTA DSA and whole Brain Perfusion acquired intermittently within 60 seconds with effective dose less than 5 mSv ($k=0.0021$)* providing flow and functional information.

*AAPM Report 96

the imaging procedures utilized during the acute inpatient episode of care, focusing on the changes in the diagnostic workup, inpatient length of stay and discharging disposition since acquiring the Aquilion ONE. Inpatient data sets from July to September 2007, prior to the Aquilion ONE installation, were compared with data sets from July to September 2009 (phase one) and July to September 2010 (phase two), which utilized the Aquilion ONE, and concerned the top three discharging ICD-9-CM codes.

Comparing the patient workups during these two time periods found significant differences in the diagnostic workup of how acute stroke patients were diagnosed. For the 2007 data set, the majority of patients were imaged using pre-MRI screening and X-ray imaging, limited brain MRI, MR perfusion, and MRA of the head and neck. MR was the primary modality used due to the limitations in CT brain perfusion at that time. Once the SCC installed the Aquilion ONE, the 2009 and 2010 data showed a significant shift in the diagnostic work up for acute stroke with the use of non-contrast head CT, CT perfusion, CTA head and neck, and MRI brain non-contrast. This expanded use of CT during stroke diagnosis resulted in reduced healthcare costs and improved patient outcomes as MR is more resource intensive and costly. Furthermore, the images produced by CT allow patients to be moved more quickly into intervention.

When the SCC analyzed the length of stay, discharge disposition and healthcare costs for the top three ICD-9-CM codes for stroke and compared the 2007 and 2009 data sets, the results demonstrated the initial benefits 320-detector row technology brought the facility and patient community. Highlights of the 2009 findings include the following (full data set on file):

2009 Length of Stay Data

| ICD-9-CM Code | 2007 Inpatient Cases — Average Days Length of Stay (w/o Aquilion ONE) | 2009 Inpatient Cases — Average Days Length of Stay (w/ Aquilion ONE) | Reduction in Average Days Length of Stay (w/ Aquilion ONE) |
|---|---|--|--|
| 434.91 – Unspecified Cerebral Artery Occlusion with Cerebral Infarction | 6.03 | 5.58 | 0.45 |
| 435.9 – Unspecified Transient Cerebral Ischemia | 2.69 | 2.55 | 0.14 |
| 434.11 – Cerebral Embolism with Cerebral Infarction | 7.3 | 7.16 | 0.14 |

The SCC's use of the Aquilion ONE in diagnosing acute stroke resulted in a significant reduction in patient length of stay, particularly for ICD-9-CM code 434.91 in 2009 (nearly half a day on average).

2009 Change in Discharge Disposition

| ICD-9-CM Code | Change in Discharge Disposition from 2007 to 2009 |
|---|---|
| 434.91 – Unspecified Cerebral Artery Occlusion with Cerebral Infarction | 19.5% increase to home 30.1% decrease to skilled nursing facilities |
| 435.9 – Unspecified Transient Cerebral Ischemia | 76.4% increase in patients discharging to home healthcare |
| 434.11 – Cerebral Embolism with Cerebral Infarction | 62.8% increase to home 25.8% decrease to skilled nursing facilities 36.5% decrease in transferred to rehabilitation |

Diagnosing stroke with the Aquilion ONE improved the discharge disposition for patients at the SCC. For example, patients falling under ICD-9-CM code 434.11 saw a 62.8 percent increase in being discharged home.

2009 Healthcare Cost Savings

| ICD-9-CM Code | Quarterly Diagnostic Workup Cost Savings | Quarterly Length of Stay Cost Savings | Quarterly Total Cost Savings |
|---|--|---------------------------------------|------------------------------|
| 434.91 – Unspecified Cerebral Artery Occlusion with Cerebral Infarction | \$41,223 | \$77,144 | \$118,367 |
| 435.9 – Unspecified Transient Cerebral Ischemia | \$23,299 | \$19,443 | \$42,742 |
| 434.11 – Cerebral Embolism with Cerebral Infarction | \$17,248 | \$12,152 | \$29,400 |

In total, for just the three ICD-9-CM codes studied, the SCC achieved an estimated annualized savings of more than \$760,000 in 2009 by utilizing the advanced technologies of the Aquilion ONE in diagnosing acute stroke.

The utilization of the Aquilion ONE and its ability to perform whole brain perfusion studies resulted in tremendous benefits for the SCC and its patients in year one. For ICD-9-CM code 434.91 (Unspecified Cerebral Artery Occlusion with Cerebral Infarction) the SCC saw almost a half-day reduction in hospital stay, had more patients discharged to home and saw quarterly cost savings in the neighborhood of \$120,000.

ICD-9-CM codes 435.9 (Unspecified Transient Cerebral Ischemia) and 434.11 (Cerebral Embolism with Cerebral Infarction) also saw improvements in these areas. Both had a reduction in hospital stay of 0.14 days and substantial cost savings. Overall, for just these three ICD-9-CM codes, the SCC achieved an approximate annualized savings of more than \$760,000 in 2009.

Following the successful use of the Aquilion ONE to improve patient outcomes in 2009, the SCC knew it could continue to make improvements to achieve even greater results. Analyzing the 2010 data found this to be the case:

2010 Length of Stay Data

| ICD-9-CM Code | 2007 Inpatient Cases — Average Days Length of Stay (w/o Aquilion ONE) | 2009 Inpatient Cases — Average Days Length of Stay (w/ Aquilion ONE) | 2010 Inpatient Cases — Average Days Length of Stay (w/ Aquilion ONE) |
|---|---|--|--|
| 434.91 – Unspecified Cerebral Artery Occlusion with Cerebral Infarction | 6.03 | 5.58 | 5.24 |
| 435.9 – Unspecified Transient Cerebral Ischemia | 2.69 | 2.55 | 2.51 |
| 434.11 – Cerebral Embolism with Cerebral Infarction | 7.3 | 7.16 | 6.93 |

In 2010, the SCC saw an even greater reduction in patient length of stay, demonstrating quicker recovery times and ultimately lower healthcare costs.

2010 Change in Discharge Disposition

| ICD-9-CM Code | Change in Discharge Disposition from 2007 to 2010 |
|---|--|
| 434.91 – Unspecified Cerebral Artery Occlusion with Cerebral Infarction | 14.8% improvement in patients discharging to home 88.3% improvement in patients discharging to home healthcare 48% reduction in patients discharging to skilled nursing facilities |
| 435.9 – Unspecified Transient Cerebral Ischemia | 23.3% increase in patients discharging to home healthcare |
| 434.11 – Cerebral Embolism with Cerebral Infarction | 20% improvement in patients discharging to home 33% improvement in patients discharging to home healthcare 45% reduction in patients discharging to rehab |

The discharge disposition for patients at the SCC continued to improve in 2010 with further use of the Aquilion ONE. For example, patients falling under ICD-9-CM 434.11, the most resource intensive code, saw a 45 percent reduction in being discharged to rehab in the 2010 data.

2010 Healthcare Cost Savings

| ICD-9-CM Code | 2009 Quarterly Total Savings | 2010 Quarterly Total Savings |
|---|---------------------------------|---------------------------------|
| 434.91 – Unspecified Cerebral Artery Occlusion with Cerebral Infarction | \$118,367 | \$197,962 |
| 435.9 – Unspecified Transient Cerebral Ischemia | \$42,742 | \$43,856 |
| 434.11 – Cerebral Embolism with Cerebral Infarction | \$29,400 | \$86,672 |
| Quarterly Savings Total | \$190,509 | \$328,490 |
| Annualized Savings Total | \$762,036 | \$1,313,960 |

In total, over the past two years, the SCC has achieved more than \$2 million in annualized savings by using the Aquilion ONE to diagnose stroke.

The 2010 data shows even more improvements over the pre-Aquilion ONE 2007 data and also demonstrates how the SCC continues to find ways to maximize the technology for year-over-year patient and economic benefits. For example, ICD-9-CM code 434.91 (Unspecified Cerebral Artery Occlusion with Cerebral Infarction) saw its average patient length of stay drop another third of a day to 5.24, with an 88 percent improvement in patients discharged to home healthcare, resulting in total quarterly cost savings of around \$197,962.

ICD-9-CM codes 435.9 (Unspecified Transient Cerebral Ischemia) and 434.11 (Cerebral Embolism with Cerebral Infarction) also saw additional improvements in the 2010 data. Both had further reductions in average patient length of stay, improvements in discharge disposition and significant cost savings. Overall, for just these three ICD-9-CM codes, the SCC achieved an approximate annualized savings of \$1.3 million in 2010, totaling a cost savings of more than \$2 million in the two years since installing the Aquilion ONE.

Bringing These Benefits to Other Healthcare Facilities

The SCC is an impressive example of how an exceptional multidisciplinary team with comprehensive education and community outreach can use innovative imaging technology to improve financial performance in today's uncertain times. Healthcare facilities everywhere can experience the significant cost savings achieved through reduced length of stay, reduction in outpatient services, reduced complications and lower recurrence of readmission.

Make no mistake, transitioning effectively to episode-based care requires more than just superior imaging technology. It will require multidisciplinary cooperation and collaboration, and Toshiba's offering of a multidimensional knowledge base, dynamic customer interaction and a robust support system of training and education will help healthcare organizations transition and prosper within the new healthcare directives.

The reality is that hospitals that choose not to participate in the national pilot program will be at risk of losing market share because Medicare patients will be encouraged to utilize participating facilities. The healthcare providers who embrace this new concept can not only retain but even increase market penetration. Toshiba has a proactive approach with the knowledge base, customer support and technology to help healthcare organizations transition successfully and succeed.

More Efficient and Accurate Stroke Diagnosis with Toshiba Imaging Technology

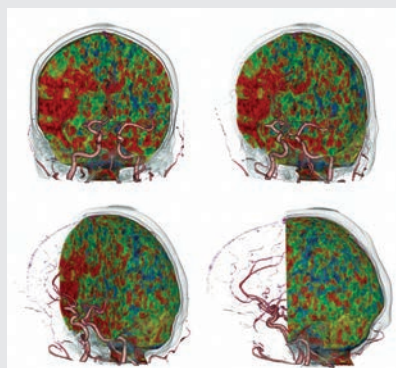
TOSHIBA'S AQUILION ONE – CHANGING CLINICAL PATHWAYS

The introduction of Toshiba's Aquilion ONE dynamic volume CT system changed the scope of cerebral perfusion analysis by enabling dynamic imaging of the entire brain and the ability to reduce diagnosis time from hours or days to minutes. Unlike any other CT system available, the Aquilion ONE covers up to 16 cm of anatomy using 320 ultra-high-resolution 0.5 mm detector elements (640 slices) to image an entire organ, including the brain, in a single rotation. It can show the brain's dynamic blood flow and real-time function, which is crucial for stroke patients and enables rapid and accurate diagnosis when time is critical.

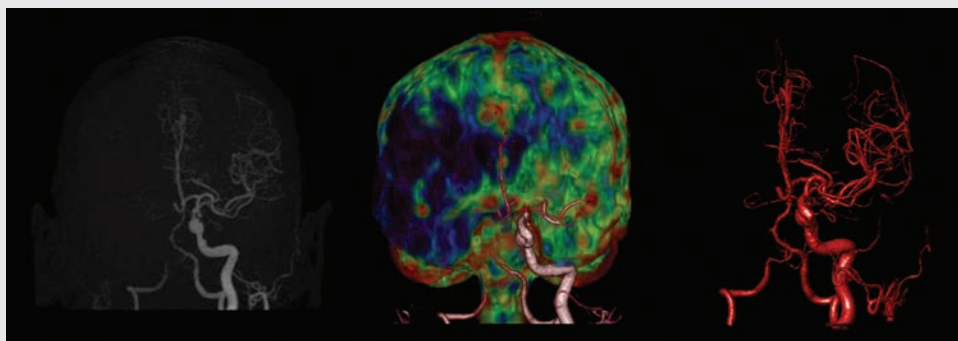
With whole brain perfusion and digital angiography, the Aquilion ONE gathers the information clinicians need to evaluate the penumbra, the region impacted by the stroke. With a single axial rotation, a non-contrast examination of the brain can be performed in one second. If no hemorrhage is found, a single injection of contrast material can be administered and the entire brain is imaged intermittently over 60 seconds. This single exam takes less than one minute and produces data showing the individual arterial or venous phase to look at digital subtraction angiography with full blood flow information. It also shows whole brain volumetric perfusion.

By pairing whole brain imaging with the Singular Value Decomposition Plus (SVD+) delay-insensitive perfusion algorithm, the Aquilion ONE produces the most advanced CT perfusion imaging in the industry. SVD+ uses a novel technique to account for delays between the arterial input function and the tissue curve, correct for noise and perform calculations with fast computation times. The SVD+ algorithm is unique in that it shifts the artery curve so that it always begins just prior to the contrast arriving in the tissue curve. It also uses a unique pre-conditioning technique that stabilizes the algorithm, minimizes noise and ensures accurate, delay-insensitive calculations of mean transit time. As a result, the Aquilion ONE produces new maps providing more information clinicians can use to accurately and quickly diagnose neurological conditions.

Beyond brain imaging, the Aquilion ONE features a full suite of dose reduction technologies that limit radiation dose to the lowest possible amounts while maintaining the highest clinically appropriate image quality needed for diagnosis.



3D Whole Brain CT Perfusion fused with CT Angiography (CTA) demonstrates right middle cerebral artery (MCA) occlusion and perfusion defect.



Maximum Intensity Projection (MIP), 3D whole Brain CT Perfusion fused with CT Angiography (CTA) and 3D CTA images demonstrate right internal carotid artery (ICA) occlusion and perfusion deficit in the right cerebral hemisphere.



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