Original Article

Evaluation of the technical specifications of computerized tomography scanners in Jazan

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Abstract

Introduction: good quality management for computerized Tomography (CT) scanners is essential to safe and efficient CT units, providing quality clinical images, maintaining patient and staff radiation doses as low as reasonably achievable. **Aims**: to evaluate the technical specifications of (CT) scanners in Jazan region in the period from 2011-2013. **Materials and Methods**: 13 CT scanners have been evaluated; 2 of them are in private sectors and the rest in public hospitals. The Technical specifications of CT scanners were assessed using template issued by ImPACT (Imaging Performance Assessment of CT scanners). **Results**: When comparing the 11 public scanners age with guidelines rules of European Coordination Committee of the Radiological and Electro medical Industries (ECCREI); it showed that scanners of Jazan region are within lifecycle guidelines, the total cumulative number of scanners since 1984 to 2013 are 15 scanners, 4 of them were replaced and the rest under use, multi detector CT scanners replaced most of the single detector scanners. for public CT scanners ; results show that all of the scanners are 3rd generation, gantry bores are arranged between70–80cm, the x-ray tube inventory showed that there is no dual source CT scanner in the region and the anode storage heat capacity ranged from (3-8MHU) except Siemens 64slices and 20slices reached up to (30MHU). All of scanners in the region are built in solid state, image reconstruction time display per second is ranged from 1-40slice/seconds, advance clinical application software are available among the scanners. Jazan region CT scanners have a high capability and their technical specifications are in a rapid pace in developments that impacting on performance which depends on trade-off between image quality and patient dose.

Key words: Computerized tomography scanner, Jazan, purchasing, quality management

INTRODUCTION

The use of computerized tomography (CT) for medical diagnosis has increased over the past decades, resulting in increasing patient radiation dose from this imaging modality.[1,2] The introduction of 64-slice CT scanners has further increased the patient throughput and the application for CT. There is a growing concern that radiation exposure from diagnostic imaging will increase the risk of cancer.[3]

The National Council on Radiation Protection in the USA has estimated that the contribution of medical radiation to the population collective dose has increased from 15% in 1980 to 53% in 2006, with CT accounting for the major share of this increase at approximately 1.5 mSv/capita/year.[4] Similar increases have been noted in the United Kingdom and this trend is common to most developed countries. The introduction of spiral CT scanners in 1989 and subsequently multislice CT detectors in 1998, represented major highlight in the development of CT scanners.[5]

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Jazan region is a smallest region in south Saudi Arabia, population are 1,300,110 (Census 2010), 23% of the CT scanners are found in the king Fahad central hospital (KFCH); this is due to hospital size and rush of work as the hospital contains almost all of the medical specialty and the other hospital transfer most of the critical cases to (KFCH). The remaining 77% of the scanners are distributed between Sabia, Abu Arish, Jazan, Samtah Biesh, Eldarb, and Feyfa hospitals as well as 2 CT units divided between Alomies private hospital and Garash polyclinic.[6]

There are many publications in comparative technical specifications for CT scanners marketing,[7-9] which are useful for suppliers, buyers, vendors and operators of scanners, specially that publications done by the center for evidence — based purchasing (CEP) is the part of national health services purchasing and supply agency (UK), role of CEP is to help buyers in technical, operational and economic considerations.[9]

For continuous quality improvement of CT scanners, CT Service delivery should meet or exceed the needs and expectations of patients and staff. A good quality management for CT scanners is essential to a safe and efficiently run CT units, providing quality clinical images while maintaining patient and staff radiation doses as low as reasonably achievable. CT purchasing specifications is the first step in continuous quality improvement of CT scanners.

The aim of this study is to evaluate and to compare the technical specifications of CT scanners in Jazan region.

MATERIALS AND METHODS

This study carried out in Jazan region in kingdom Saudi Arabia, during the period from July 2012 to July 2013, it consists of 14 provinces.

Methods of assessment

In Jazan region there are 13 CTs in clinical use; 2 of them are in private sectors and the rest in public hospital including: GE Hispeed 4 slice, Siemens Somatom Definition 64 slice, 2 GE Light speed 16 slice, GE bright speed 16 slice, Siemens Somatom Emotion 6 slice, Toshiba Aquilion 16 slices, GE bright speed 8 slices, Siemens Somatom 20 slices, Siemens emotion 1 slices and neurologica ceretom 8 slices (portable scanner), all have been evaluated.

The technical characteristics of the CT scanners were assessed by using CT manuals and retaining to CT units in the region suring of the performance from the operators. Technical specification was assessed using template issued by Imaging Performance Assessment of CT scanners, by comparing of the scanners Gantry, X-ray tube, Generators, detectors design, couch, control, console, computer, storage media, workstations, clinical software and clinical application.

CT scanners age in the region compared against guidelines published by the rules of European Coordination Committee of the Radiological and Electro medical Industries (ECCREI) for the guidelines of CT scanners age published by the ECCREI According to the rules from ECCREI.[10]

RESULTS

Analysis CT scanners in the region show that multislice CT scanners comprise of 10 (77%) of the total; where single slice CT scanners were 3 (23%) of the total.

DISCUSSION

In Jazan region the 11 public scanners are distributed among 9 hospitals (19 public hospitals) 3 scanners are found in the central hospital (KFCH) as the central hospital almost include the whole specialty. The 13 scanners in clinical use in the region (until May 2013), that is approximately equal one CT per each hundred (100) thousands inhabitants (Population in region are 1,300,110 Census 2010), this proportion is high world-wide.[11] The majority of CT scanners (85% of the total) are in public hospital while the rest (15% of the total) are in private sectors [Tables 2 and 3].

This study presents the comparative technical specifications for public scanners only because of the un -cooperation of private sectors in the region. Table 1 presented the age of Jazan's Public CT scanners inventories, relative to the rules from the European Coordination Committee of the Radiological and Electro medical Industries (ECCREI) May, 2013 The first CT in the region was installed in 1984 at KFCH; it was Siemens Somatom single slice, the cumulative number of public CT scanners installed (1984-2013) in the region are 15 scanners, 11 scanners of them are under use and 4 CT of the total are replaced, within this period X-ray tubes are changed for estimated 10 times for the total of the 15 scanners (replaced plus in use Scanners).[6]

The result of technical specification comparison for public CT scanners in the Jazan region show that all of the scanners are 3rd generation as the 4th generation are not not widely used by the manufacturers due to difficult to stabilise rotation and expensive detector.[5]

Slice class are arranged from 1 single slice (%), 4 (%), 6 (%), 8 (%), 16 (%) which are the most abundant, as well as 20 (%) and 64 (%), which is the advanced scanner recently in the region.

Table 1: The age of Jazan's public CT scanners inventories, relative to the rules from the ECCREI May, 2013

Age of CT	ECCREI rules	Number of CT	Percentage of total
0-5 years old	At least 60% of the installed equipment base should be younger than 5 years (lifecycle guideline)	7	64
6-10 years old	Not more than 30% of the installed equipment base should be between 6 and 10 years old (percent beyond guideline)	3	27
>10 years old	Not more than 10% of the installed base can be tolerated to be older than 10 years (percent at guideline)	1	9
Age of oldest machine (years)	NA*	10.5 years old	

*NA = Not available; ECCREI = European coordination committee of the radiological and electro medical Industries; CT = Computerized tomography

Table 2: Inventory of public CT scan in Jazan region

Health institution (hospital)	Manufacturer	Scanner model	Slices acquisitions per rotation	Country of manufacturer
KFCH	Siemens	Somatom definition As	64	Germany
KFCH	GE	Hi speed NXi/pro	4	USA
KFCH	NeuroLogica	Cere tom	8	USA
Sabia general hospital	GE	Light speed xtra16	16	USA
Abu Arish general hospital	GE	Light speed xtra16	16	USA
Samtah general hospital	GE	Bright speed edge	16	USA
Eldarb general hospital	Siemens	Somatom emotion	6	Germany
Jazan general hospital	Toshiba	Aquillion one 16	16	Japan
Prince Mohamed bin Naser hospital	Siemens	Somatom definition As	20	Germany
Feyfa general hospital	GE	Bright speed edge	8	USA
Baish general hospital	Siemens	Emotion	1	Germany

KFCH = King fahad central hospital; GE = General electric; USA = United states of america

Table 3: Inventory of private CT scan in Jazan region

Health institution (Hospital)	Manufacturer	Scanner Model	Slices acquisitions per rotation	Country of Manufacturer
Alomies hospital	Siemens	Emotion	1 slice	Germany
Garash medical polyclinic	GE	Hi speed LX/i	1 slice	USA

GE = General electric; USA = United states of america; CT = Computerized tomography

Corresponding to world-wide rapid pace of change in the provision of CT in recent years, in relation to detectors racing between CT manufacturers, Jazan region also show a rapid change in most of CT scanners.

The inventory showed that the gantry bores are arranged between 70 cm, 78 cm and 80 cm, there is availability in the future for radiation therapy planning for big bore CT for 80 cm gantry bore in GE scanners, there is some exception for Ceretom scanner which has 32 cm diameter as this portable CT is used only for head and neck scanning, the same Table also shows that the gantry tilt range for all of scanners are ±30, the max scan field of view for all scanners is 50 cm, the gantry rotation times ranged between 0.33 and 4 s both Siemens Somatom 64 slice and Siemens Somatom 20 slice are the most fastest among scanners in rotation time with range of (0.33-1.5 s) [Table 4].

In the X-ray tube [Table 5], the inventory showed that there is no dual source CT scanner in the region. And the Anode storage heat capacity for the available scanners is ranged from 3 MHU to 8 MHU except Siemens somatom definition 64 slices and 20 slices in which the X-ray tube the anode storage heat capacity reached up to (30 MHU), The max anode cooling rate for scanners are ranged from 635 to 7300 in (KHU/min) except the portable scanner, which has 12 min maximum.

Most of the tube changing took place in scanners more than 5 years age. Consumption of X-ray tube may give assign for overload of cases.[6] For the Guaranteed tubes life which are variable from scanner to other they depend on the contract; either annually or by number of scans/day/year/rotation [Table 5].

The X-ray generator of all scanners are located in the gantry and are using air as cooling method, Generator max output power rating is ranging between 42 and 100 kW and the kVp range available for all scanners is (80, 100, 120, 140 kv), in detector system [Table 6] all of our scanners in the region are build in solid state i.e., there are no gas detectors which are used mainly with the 4th generation, all Siemens scanners used ultra-fast ceramic as detector material while

Table 4: Technical specification comparison (Gantry)

Gantry	GE Hi Speed	Siemens Somatom Definition	GE Light Speed	GE Bright Speed	GE Light Speed	Siemens Somatom Emotion	Toshiba Aquillion	GE Bright Speed	Siemens somatom	Siemens emotion	Neurologica Cere Tom Portable CT
CT generation(G)	4 slice 3rd G	64 slice 3rdG	16sl ice 3rd G	16slice 3rd G	16slice 3rd G	6slice 3rdG	16slice 3rd G	8slice 3rd G	20slice 3rd G	1slice 3rd G	8slice 3rdG
Gantry bore(cm)	70cm	78cm	80	70cm	80cm	70cm	72cm	70	78cm	70cm	32cm
Gantry size, h×w×d(cm)	185×182 ×91	198×117 ×231	188×223 ×107	193×204 ×101	188×223 ×107	182×78 ×230	185×23 ×101	193×204 ×101	198×117 ×231.4	182×78 ×230	153×133 ×90
Gantry weight(kg)	1269	2700	1780	1770	1780	1,300	1790	1770	2700	1,300	340
Tilt range (degrees)	±30	±30	±30	±30	±30	±30	±30	±30	±30	±30	NA
Scan fields of view (cm)	18-50	Ma×50	Ma×50	Ma×50	Ma×50	Ma×50	18-50	18-50	Ma×50	Ma×50	25
Nominal slice widths for axial scans	1-10	0.6-10	0.6-10	0.6-10	0.6-10	0.6-10	0.5-5	0.6-10	0.6-10	1-10	10
type of positioning lights	Laser	Laser	Laser	Laser	laser	Laser	Laser	Laser	Laser	Laser	Laser
Range Of Gantry Rotation Times, Sec, 360 Â°	0.7-3.0	0.33-1.5	0.5-4	0.8-4	0.5-4	0.35-1.5	0.5-4	0.8-4	0.33-1.5	0.7-3.0	2

Table 5 Technical Specifications Comparison (X-Ray Tube)

X-Ray Tube	GE HiSpeed Nxi/pro	Siemens Somatom Definition	GE LightSpeed	GE BrightSpeed	LightSpeed	Siemens Somatom Emotion	Toshiba Aquillion	GE BrightSpeed	Siemens Somatom Definition	Siemens emotion	Cere Tom Portable CT
Type and make	GE INSERT	Siemens Straton MXP	GE Performix Grounded Metal Ceramic Tube	GE Solarix 350	GE Performix Grounded Metal ceramic Tube	Siemens DURA 422MV	CXB-750D	GE Solarix 350	Siemens Straton MXP	Siemens DURA 422MV	Neurologica Cere Tom Fixed Anode
Anode storage heat capacity (MHU)	6.3	0.6 -30	8	5	8	6	7.5	5	0.6 -30	3	6
Max anode Cooling rate (KHU/min)	840	7300	1782	840	1782	810	1386	840	7300	635	12
Method of tube cooling	Oil/air	Chilled water	Oil / air	Oil / air	Oil / air	Oil	Liquid	Oil /air		Oil	Oil/air
Focal spot size (mm) (W)×(L)	S (0.7×0.5) L (0.9×0.9)	S 0.7×0.7 L 0.9×1.1	0.7×0.6 0.9 × 0.9	0.8×0.5 1.1 ×1.0	0.7×0.6 0.9 ×0.9	0.8×0.5 0.8×0.7	0.9×0.8 0.6×1.4	0.8×0.5 1.1×1.0	7×.7 9×1.1	0.8×0.5 0.8×0.7	1mm×1mm
Guaranteed tube life	1year	1years	1year	6000 Exam	1year	3000-5000 Exam	300000 Rotation per second	6000 exam	1years	130.000 Scan per second	I000scan/ yr Approx= 3scan/day

GE scanners used highlight lumex, image reconstruction time display per seconds is ranged from 1 slice/s up to 40/s for Siemens 64 slices, Toshiba has the large number of detectors along the (z) axis and so large number of detection channels per row between the scanners, minimum slice thickness of scanners in the region are ranged from 0.5 to 1.5 mm.

In Table 7, the control console for Siemens scanners are always of only one monitor used for patients data, acquisitions, viewing, clinical software evaluation as well as filming in addition to the workstation but for GE they using two monitors, one for patient data base and the other for acquisitions, viewing, clinical software evaluation and filming, also all of the scanners are using liquid crystal display monitors of 19-21 inches, with image matrix ranging between (512 × 512), (768 × 768) and (1024 × 1024) megapixel. The CT dose index volume and dose length production which express the CT dose are displayed on the screen for all scanners

Table 6 Technical Specifications Comparison (Detection System)

Detection System	GE Hi Speed Nxi/pro	Siemens Somatom Definition	GE LightSpeed	GE BrightSpeed	GE LightSpeed	Siemens somatom Emotion	Toshiba Aquillion	GE BrightSpeed 8 slice	Siemens somatom 20 slices	Siemens emotion 1 slice	Cere Tom Portable CT
Detector Type	Solid state array	Solid state array	Solid state array	Solid state array	Solid state array	Solid state array	Solid state array	Solid state array	Solid state array	Solid state array	Solid state array
Detector Material	(HiLight-Lumex)	Siemens UFC	GE HiLight matrix II Lumex	GE HiLight Matrix Lumex	GE HiLight Matrix II Lumex	Siemens UFC	Gadolinium oxysulphide GOS	GE HiLight Matrix lumex	Siemens UFC	Siemens UFC	NA
Number Of Detectors	16	32	24	24	24	24	40	24	24	12	20
Number Of Detection Channels/ Row	16×816 total 13,056	736×32 total 23552	24×888 total 21,312	24×880 total 21,120	24×888 total 21,312	24×736 total 17663	40×896 total 35840	24×880 total 21,120	24×888 total 21,312	12×816 total 6528	408×20 total 8160
Effective Length Of Detector Elements	20	38.4	20	20	20	20	32	20	20	12	20
Image Reconstruction Time Display	6 frames/ second	40 slices/sec	6 slices/sec	3 frames/ second	6 slices/sec	6 images/s	10 images/s	3 frames/ second	40 images/s	1 slices/sec	4-8 image/s
Min Slice Thickness (mm)	0.5	0.6	0.625	0.63	0.625	0.63	0.5	0.63	0.5	0.5	1.5

Table 7 Technical Specifications Comparison (Control Console)

control console	GE HiSpeed Nxi/pro	Siemens somatom definition	GE LightSpeed	GE Bright Speed	GE Light Speed	Siemens somatom Emotion 6	Toshiba aquillion	GE Bright Sped 8slice	Somatom 20 slices	Siemens emotion 1slice	Cere Tom Portable CT
Dimension of desktop WXL (cm)	1.5×2	33×900	NA	NA	NA	Site dependant	330×900	NA	NA	NA	72×43
Scan control method	KB, mouse trackball	KB and mouse	KB, mouse, trackball	KB, mouse, trackball	KB, mouse trackball	KB, mouse, scan control	Left& right Front& back	KB, mouse trackball	KB, mouse	Left& right Front& back	KB, mouse
No of monitor at console	1	1	2	2	2	1	2	2	1	1	2
Function of each monitor	Acquisition, PT database, viewing, clinical software evaluation, filming	Acquisition, PT data base, viewing, clinical software evaluation, filming	PT data base for Acquisition, review and processing	PT data base for Acquisition, review and processing	PT data base for Acquisition, review and processing	Acquisition, PT data base, viewing, clinical software evaluation, filming	PT data base for Acquisition, review and processing	PT data base for Acquisition review and processing	Acquisition, PT database, viewing, clinical software evaluation, filming	PT data base for Acquisition, review & processing	Acquisition, PT database, viewing, clinical software evaluation, filming
Display type and dimension of image screen (inch)	NEC LCD, 19 inches	Siemens LCD, 19 inches	NEC multisync LCD 1990sxi 19 inches	NEC multisync LCD 1990sxi 19 inches	NEC multisync LCD 1990sxi 19 inches	Siemens LCD, 19 inches	LCD, 19 inches	NEC multisync LCD 1990sxi 19 inches	Siemens LCD, 19 inches	Siemens LCD, 19 inches	Neurologia LCD, 17 inch
Image matrix Display and resolution in (megapixel)	1024+1024, 512×512 768×768	1024×1024	1024×1024, 512×512 768×768	1024×1024, 512×512 768×768	1024×+1024, 512×512 768×768	1024+1024	1024×1024, 512×512	1024×1024, 512×512	1024×1024, 512×512 768×768	512×512	1920×1200
CTDI v and DLP On the screen	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

KB= Key board, NA=not available, PT=patient

which facilitate in estimating the doses for both staff and patients. Main computer model is distributed between (hp) for GE scanners and Fujitsu for Siemens and the computer operating system distributed between windows XP for Siemens scanners and Linux for GE scanners, the type of CPUs for the computer system are variable there is intel Pentium xeon, and dual core to duo, also the range of CT numbers display for most of scanners is between −1024 and +3071 (HU) with exception of Siemens Somatom definition 64 slices which has CT number range from −10,240 to +30,710, image storage show that the maximum hard disk capacity is ranged

between 40 (G bytes) and 30 × 1024 (tetra) for Siemens Somatom emotion 6 though the later scanner is exist in small hospital and there is no rush of patients in the hospital, the hard disk capacity for image storage (in Gbytes), number of images is ranged from 20,000 for GE Hispeed 4 slices to 520,000 Images for Siemens somatom definition as 64 slices.

Workstations as in [Table 8] are available with all CT scanners of the region except the portable CT cereTom and GE Hispeed NXi pro. Furthermore most of the workstations of the scanners are with two monitor.

Table 9 declares that all CT units of the region have an advanced reconstruction and 3D display with exception to GE HiSpeed, which has only multi-planar reconstruction and Siemens emotion 1 slice in which there is no advanced reconstruction and 3D display as its single slice.

Clinical application software for advanced scanning [Table 10] are almost available among the region scanners, but most of the applications are not in use this is mainly due to lack of specialty and the poor knowledge of the physician about the efficacy of CT scanners and their poor knowledge about the advanced scanning. For example bone mineral densitometry this software is available in 7 out of the 11 scanners, but the percentage of application is 0%, virtual colonscopy in 8 out of total scanners and also not in use, cardiac imaging is found in 2 out of all but not applicable as well as CT perfusion software, in the region though its available among 8 scanners, dental and CT fluoroscopy as software both of them are available in 8 out of the 11 scanners and they are not applicable, for radiotherapy CT simulation software is neither available nor applicable as there is no radiation therapy center in the region, CT angiography is available in 8 scanners out of the total, with application of 2 out of the total scanners (18%) though it can be available in some scanners from the 3D maximum intensity projection.

Table 8 Technical Specifications Comparison (Independent Work Station)

Independent workstation	GE HiSpeed Nxi/pro	Siemens Somatom Definition	GE Light Speed	GE Bright Speed	GE Light speed	Siemens Somatom Emotion	Toshiba aquillion	GE Bright Speed	Siemens somatom	Siemens emotion	Cere Tom portable
Workstation Provided	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	yes	Yes	NA
Computer Make And Model	HP workstation XW8200	Siemens fujitsu	HP workstation XW8200	HP workstation XW8200	HP workstation XW8200	Siemens fujitsu	Toshiba	HP workstation XW8200	Siemens fujitsu	Siemens fujitsu	—
Operating System	—	Windows XP	Intel inside xeon	Intel inside xeon	Intel inside xeon	Windows XP	Windows	Intel inside xeon	Windows XP	Window xp	—
Type , Speed Of CPU	—	intel Xeon 2×2.66	Intel core 2du 2×3.2	Intel core 2du 2×3.2	Intel core 2du 2×3.2	Dual core Pentium 2×2.66	Dual core 2due	Intel core 2du 2×3.2	intel Xeon 2×2.66	Dual core pentium 2×2.66	—
Amount RAM (Mbytes)	—	8	6	6	6	6	6	6	8	6	—
No Of Monitors, Type And Size	—	1,Siemens LCD, 19inches	2,NEC multisync LCD1990sxi19 inches	2,NEC multisync LCD1990sxi 19 inches	2,NEC multisync LCD1990sxi 19 inches	1,Siemens LCD, 19 inches	1,Toshiba LCD, 19 inches	2,NEC multisync LCD1990sxi 19 inches	1,Siemens LCD, 19inches	1,Siemens LCD, 19 inches	—

Table 9 Technical Specifications Comparison (Advanced Reconstruction Display)

Advanced reconstruction display	GE HiSpeed Nxi/pro	Siemens Somatom	LightSpeed	BrightSpeed	LightSpeed	Siemens somatom emotion	Toshiba Aquillion	GE BrightSpeed	Siemens definition	Siemens Emotion	Cere Tom Portable CT
MIPs and MinIPs	NA	AV	AV	AV	AV	AV	AV	AV	AV	NA	AV
SSD (3D Shaded Surface Display)	NA	AV	AV	AV	AV	AV	AV	AV	AV	NA	AV
MPR (Multi-planar reconstruction)	AV	AV	AV	AV	AV	AV	AV	AV	AV	NA	AV
3D volume rendering software	NA	AV	AV	AV	AV	AV	AV	AV	AV	NA	Available Not in use
3D virtual endoscopy	NA	AV	AV	AV	AV	AV	AV	AV	AV	NA	NA
Planes available in (MPR)	All planes	All planes	All planes	All planes	All planes	All planes	All planes	All planes	All planes	All planes	All planes

NA: (not available), AV (available) 3D: three dimension, MIPs: Maximum intensity projections, MinIPs: Minimum intensity projections

Table 10: Technical Specifications Comparison (Clinical Application Software)

Clinical application software	GE Hi Speed Nxi/pro	GE Siemens Somatom	GE Light Speed	GE Bright Speed	GE Light Speed	Siemens somatom emotion	Toshiba Aquillion	GE Bright Speed	Siemens somatom	Siemens emotion	Cere Tom Portable CT
Bone mineral densitometry	NA	AV but not in use	AV but not in use	AV but not in use	AV but not in use	3D	AV but not in use	AV but not in use	AV but not in use	NA	NA
Virtual colonoscopy	NA	A/V but not in use	AV	AV but not in use	AV	AV	AV but not in use	AV but not in use	AV but not in use	NA	NA
CT angiography	NA	A/V, done always	AV but not in use	AV but not in use	AV but not in use	AV from 3D MIP	AV but not in use	NA	AV and in use always	NA	H&N CT Angiography not in use
CT perfusion software	NA	AV but not in use	AV but not in use	AV but not in use	AV but not in use	AV but not in use	AV but not in use	NA	AV but not in use	NA	AV but not in use
Dental	NA	AV but not in use	AV	AV but not in use	AV but not in use	AV but not in use	AV but not in use	AV but not in use	AV but not in use	NA	NA
Radiotherapy CT simulation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cardiac applications	NA	AV but not in use	NA	NA	NA	NA	NA	NA	AV but not in use	NA	NA
CT fluoroscopy Software	NA	AV but not in use	AV but not in use	AV but not in use	AV but not in use	AV but not in use	AV	AV but not in use	AV but not in use	NA	NA

CT scanner markets are driven by the trend towards multi-slice scanners; the global market for CT scanners was valued at $3.7 billion in 2012. Total market value is expected to reach $6 billion by 2019.[4]

CT scanners are purchased in general either to supplement an older scanner to meet the increased demands on services or to take advantage of new developments that enable improved diagnostic faster throughput or any other clinical benefits, CT scanners are, however expensive both to purchase and to operate, hence it's important to select the scanner which offers greatest value of money.

Purchasers are to select scanners that meet their needs of the clinical environment(s) for which it is intended. The significant challenge for buyers is the fact that — even though manufacturers follow international standards when specifying CT performance — different companies' specifications are not necessarily stated in the same terms. Therefore, buyers often need to obtain further information and conduct additional analysis.

CONCLUSION

Jazan region scanners have a high capability in clinical software with less application. Technical specification of CT scanner was found to be within the standard criteria and it is one of the most important aspects to be considered by buyers in addition to operation and economic considerations.

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