

Entry-level role task performance criteria for the cardiovascular technology domain

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Abstract

Objectives: This study aims to identify entry-level role task performance criteria for the development of competencies in the cardiovascular technology domain.

Methods: A task analysis survey instrument was aligned with the CanMEDS 2005 physician competency framework along with other competency documents from the cardiovascular technology domain to collect data on performance criteria using recognized areas of competence for health professionals and to ensure a broad coverage of relevant role task definitions. The research targeted practitioners from 35 tertiary care centers across Saudi Arabia where cardiovascular technology services are utilized. Entry-level performance criteria identified in the survey were then used as inputs for a proposed competency profile for the cardiovascular technology field.

Results: A total of 182 email invitations were sent with a response rate of 52% (n=95), generating participants from

17 of the 35 centers targeted. Respondents included 59 Saudi nationals, 29 Filipinos, three South Africans, two Jordanians one American and one missing data entry for nationality. In total, 88 entry-level performance criteria were identified and two areas of deficiency in current cardiovascular technology training and scope of practice were highlighted.

Conclusions: Aligned with the purpose of outcomes-based education, this study offers an initial step toward further development of competencies for the cardiovascular technology domain using a well established competency framework, and highlights the need to increase emphasis on training and development of clinical expertise and attitudes toward more patient-centered care.

Keywords: Competency-based education, performance criteria, CanMEDS, cardiovascular technology

Introduction

The field of cardiovascular technology (CVT) has advanced rapidly over the last several decades, increasing demands on the knowledge, skills and attitudes required to effectively work in the broad spectrum of patient care areas it serves.^{1,2} Traditionally separated into subspecialties to support invasive or noninvasive procedures, CVT specialists play an important role in patient care during cardiac catheterizations, vascular interventions, echocardiography studies, holter/stress monitoring and electrocardiogram (ECG) recording and analysis. Based primarily on either North American or European training standards, scope and practice of the subspecialties within the CVT domain varies depending on the level of training, can overlap with one another and is greatly impacted by the political and profes-

sional influences that shape health policies of the geographical region or institution where work is carried out. For example, the VIR technologist who in one setting is responsible for maintaining a sterile field and communicating directly with the patient while monitoring progress of the procedure may have a reduced role in another setting where a nurse specialist performs some or all of these tasks.

Within the invasive subspecialties, the cathlab technologist, cathlab radiology technologist and electrophysiology technologist work closely together to assist the physician during complex diagnostic and therapeutic interventions in the cardiac catheterization laboratory and are often cross-trained to perform multiple roles, while the vascular interventional radiology technologist is highly trained to assist in

a wide range of procedures dedicated to the treatment of vascular pathologies.

For the noninvasive subspecialties, the echocardiography technologist receives extensive training in hands-on bedside performance and interpretation of echocardiography studies as well as the identification of anatomical landmarks and features, while the holter/stress lab technologist and electrocardiogram technologist share a common background being highly skilled at interpreting ECG results and recognizing signs of physiological stress during electrocardiogram recording. This diverse and rapidly advancing workplace environment requires CVT practitioners to rely heavily on training experiences if they are to continue developing as self-directed learners capable of maintaining competence in the procedural skills necessary to handle increasingly complex diagnostic instruments and other specialized equipment, stay current with advances in technology and be able to apply theory in practice while fostering qualities of professional conduct and ethical behavior in patient care.

To help graduates of health professions better prepare for the real world challenges they will face, the Ministry of Higher Education (MOHE) in Saudi Arabia is currently aligning post-graduate medical education and other allied health disciplines with competency-based education.³ In a drive to improve its educational structure, the MOHE has joined worldviews on innovations in curriculum reform that shift away from a central core of educational processes, emphasizing instead the evaluation of competencies and the importance of learning outcomes. Carraccio et al. define competency as a set of demonstrable behaviors derived from the learner's knowledge, skills and attitudes that portray the individual's personal ability in a given task.⁴ Gonczi asserts that competency-based education improves the link between practice and theory, promotes knowledge application over knowledge acquisition, advances a more self-directed learning style, offers the potential to improve validity of vocational assessment methods and provides an integrated approach and sound basis for the educational reform needed to ensure accountability to public interests.⁵ The use of a task analysis to identify components of performance criteria either through direct observation of experts in action, or by having skilled practitioners verbalize behaviors during role performance has been well documented.⁶⁻⁷ Once identified, performance criteria can then be used as a starting point for an outcomes-based curriculum and the required competencies targeted by the educational program.⁷

For the purpose of developing a competency-based education curricula, Carraccio et al. propose the following four steps as a guide: competency identification, determination of performance levels, competency assessment and validation of the education program.⁴ In addressing the first step competency identification, a task analysis of the cardiovascular technology domain was undertaken to identify role

performance criteria as inputs for the development of entry-level competency requirements. As a framework for the development of outcomes-based education, CanMEDS⁸ has reached widespread use as a standard for medical education in healthcare communities throughout the world. Derived from extensive research efforts directed by the Royal College of Physicians and Surgeons of Canada, the CanMEDS framework is now being successfully embedded within accreditation, evaluation, assessment and continuing professional development programs aimed at assisting educators, trainees, healthcare professionals, public officials and patients alike.⁸ Focused on addressing what health professionals need to be able to do to practice effectively, CanMEDS describes essential abilities of a competent physician which it embodies in core competencies or roles that include a central role of Medical Expert with integrated overlapping roles of Communicator, Collaborator, Manager, Health Advocate, Scholar and Professional.⁸ Although originally implemented to describe core areas of competence for physicians, roles defined in the CanMEDS are also well suited for other health professions⁹ and can be used to help guide health professionals attain competence as experts in their field capable of managing resources and effectively communicating and collaborating with others while advocating the promotion of health, pursuing personal development through on going scholarly work and developing high standards of professional and ethical conduct.

Methods

Study design

An on-line cross-sectional survey was used to provide quantitative descriptions of demographics and identify entry-level performance criteria for the CVT domain. The research targeted 35 tertiary healthcare centers within the Kingdom of Saudi Arabia (KSA) where cardiovascular technologists are employed. To aid identification of performance criteria within the CVT domain, the survey included a task analysis with questions corresponding to the CVT roles of cath lab (CL) technologist, cath lab radiology (CLR) technologist, electrophysiology (EP) technologist, interventional vascular radiology (VIR) technologist, echocardiography (ECHO) technologist, holter/stress (H/S) lab technologist and electrocardiogram (ECG) technologist.

Study population

Permission was sought from the leadership of relevant departments to access contact lists of the targeted population and facilitates communication with prospective participants. Support from key members within the CVT field was also solicited to heighten awareness of the research and drive motivation to participate. Study subjects comprised all male and female participants currently residing in KSA as either CVT students, practicing technologists, supervisory staff and CVT department managers of both national and

international origin. Convenience sampling was used to maximize enrollment and ensure representation of all stakeholders. Enrollment in the study was voluntary and all candidates received via email an overview of the studies purpose with a link to the surveys through survey-monkey.com. All non-respondents received two reminders one week apart following the initial invitation to participate. No exclusion criteria were defined.

Survey instrument development

A paper-based pilot survey instrument was first developed to explore domain demographics and entry-level performance criteria using several information sources. CVT job descriptions and task lists were taken from employer websites within KSA along with relevant information from well-established international professional CVT bodies to form the basis of a first draft document and initial discussion points. The draft document was further refined through interviews and focus group meetings with cardiology staff and CVT technicians from the King Abdulaziz Cardiac Center (KACC) in Riyadh. Finally, two cardiology physicians and two technologists from the KACC piloted the survey instrument for validation purposes prior to data collection.

To improve quality of the survey and minimize its length, question response sequences were customized using the skip-logic feature incorporated in the website www.Surveymonkey.com so that respondents from the various CVT subspecialties were required to answer only those questions relevant to their domain of practice. The minimum and maximum number of survey questions required for the task analysis ranged between 29 and 43.

Study procedures

To identify entry-level role task performance criteria, participants were asked to review a list of job-related duties relevant to their area of expertise and indicate the frequency of performance as either 'Routinely' if the task is part of regular practice, 'Frequently' if it is not part of regular practice but done often, 'Rarely' if it is not part of regular practice but done occasionally, or 'Never' if it is not performed or non-applicable as an entry-level task. To determine a cutoff point, results were aggregated into two groups combining responses for 'Routinely/Frequently' and 'Rarely/Never'. Each task was considered relevant if the cumulative percent of responses for 'Routinely/Frequently' was greater than responses for 'Rarely/Never'. When responses were equal, a decision to retain the task was reached by consensus using the criteria "entry-level task". Survey outcomes were then analyzed and used to form a proposed list of entry-level role performance criteria for the CVT domain.

The CanMEDS Framework was utilized as a model template to align proposed CVT performance criteria with recognized areas of competence for health professionals.⁸ As

a starting point, general definitions relevant to the CVT field and scope of practice were first formed to identify with the seven CanMEDS roles; medical expert, communicator, collaborator, manager, scholar, health advocate and professional.⁸ Following the creation of role definitions, tasks from the proposed list of performance criteria were then matched by consensus with a corresponding role to form either core competencies that could be used across the entire CVT domain, or key competencies relevant to one or more of its seven sub-specialties. The role-task groupings were then compared to well-established competency profiles from the Canadian Society for Cardiovascular Technology (CSCT) and the Canadian Association of Registered Diagnostic Ultrasound Professionals (CARDUP)^{10,11} to assess the task analysis for completeness and ensure a broad coverage of applicable role task definitions.

Data analysis

Completed surveys were collected through survey-monkey.com and the generated quantitative data was entered into PASW Statistics v.18 to tabulate descriptive statistics of all research variables (SPSS Inc., 2009, Chicago, IL). Data is presented as frequencies and percentages where appropriate. No personal identification was requested and all information obtained in the study remained anonymous to ensure participant confidentiality.

Ethical approval

Grant approval for this research was obtained from the institutional review board (IRB) of the King Abdullah International Medical Research Center (KAIMRC).

Results

Study demographics

A total of 182 email invitations were sent out with a response rate of 52% (n=95). Respondents from 17 tertiary care centers across Saudi Arabia participated in the survey, including nine respondents in supervisory roles, 17 cathlab technologists, five electrophysiology technologists, five cath lab radiology technologists, 11 vascular interventional radiology technologists, 17 echocardiography technologists, five holter/stress technologists, 11 electrocardiogram technologists, seven students enrolled in a post-bachelor diploma program in cardiovascular technology at the King Saud bin Abdulaziz University for Health Sciences and eight missing data entries for occupation. From the total number of respondents, 89% (n=85) completed the survey while 11% (n=10) were excluded due to insufficient data. From the completed surveys, 13% (n=11) contained some missing data. From the total number of valid responses, 47% (n=40) were female, 53% (n=45) were male, while Saudi nationals formed 60% (n=51) of this study population. Most have completed a bachelor's degree (59%, n=50) and have less than ten years of work experience (69%, n=59) (Table 1).

Table 1. Demographic data for CVT technologists (N=85) in Saudi Arabia (2011)

Variable	Saudi (n=51)		Non-Saudi (n=34)		Total (n=85)	
	n	(%)	n	(%)	n	(%)
Gender						
Female	15	(29)	25	(74)	40	(47)
Male	36	(71)	9	(27)	45	(53)
Age						
20-30 years	31	(61)	6	(18)	37	(44)
31-40 years	16	(31)	16	(47)	32	(38)
41-50 years	4	(8)	7	(21)	11	(13)
>50 years	-	-	5	(15)	5	(6)
Highest level of education achieved						
Diploma	24	(47)	2	(6)	26	(31)
Bachelor degree	19	(37)	31	(91)	50	(59)
Master degree	7	(14)	1	(3)	8	(9)
Missing	1	(2)	-	-	1	(1)
Work experience						
0-5 years	21	(41)	10	(29)	31	(37)
6-10 years	17	(33)	11	(32)	28	(33)
11-15 years	7	(14)	5	(15)	12	(14)
>15 years	6	(12)	8	(24)	14	(17)

Task analysis outcome

In total, 23 core and 65 key role performance criteria were identified (Appendix A). Three core performance criteria related to the communicator role required a consensus decision to retain due to equal response rates, 18 other performance criteria were rejected out-right and one additional criterion was identified as missing from the original task analysis through an ECHO group respondent's comments to the open-ended survey question "Please use the space provided to list additional tasks and their frequency".

Of the seven CVT subspecialties surveyed, participants from VIR were the only group to retain all core and key performance criteria without the need for a consensus decision. All groups except for VIR and CL scored low in the scholar role resulting in one of two performance criteria being rejected, while the CL, EP and CLR groups all scored low on health advocacy resulting in the same. The CLR group also rejected one-performance criteria from its core manager role, while the H/S group rejected one of its core communicator roles. All groups except for CL, EP and ECHO retained 100% of their key expert role performance criteria. The CL group rejected six of 11 (55%) key expert performance criteria, while the EP and ECHO groups rejected 10% (n=1), and 8% (n=1) respectively.

Discussion

As its principal aim, this research utilized a task analysis aligned with the CanMEDS framework to explore roll task performance criteria of seven subspecialties within the CVT domain. Results from this study identified the roles of health advocate and scholar as not being well supported in current CVT training and scope of practice, and revealed

that participant self-awareness and attitude toward the role of health advocate may be related to the level of patient interaction during role performance.

Following information gathering and role alignment with established CVT competency profiles during survey instrument development, performance criteria for the health advocate role were missing while only one performance criterion related to participation in continuing education activities had been established for the scholar role, indicating a deficiency in current CVT training and scope of practice. The additional performance criteria for these roles had to first be adapted from the CanMEDS framework to be included in the survey. Compounding this finding is the fact that three out of seven groups (43%) rejected one of the adapted health advocate performance criteria while five out of seven (71%) rejected the added scholar role, suggesting that these performance criteria are not well recognized at entry-level. As part of the CanMEDS framework, these roles have been established as important entry-level areas of competence for health professions where advancing current knowledge, promoting best practice and developing more patient-centered care are concerns. These outcomes point to needed improvements in CVT educational curricula aimed at developing graduates from this domain into more reflective, lifelong learners capable of using methods of inquiry to advance practice while keeping the health needs and best interests of the communities they serve as a central focus.

Another aspect revealed in this research is the unexpected, but possible relationship between attitudes toward health advocacy and level of patient interaction during role performance. While differentiating the CVT domain into groups according to similarities in practice, it can be appreciated that the CL, CLR, EP and VIR groups assist during invasive procedures in surgical suits or sterile environments, while the ECHO, H/S and ECG groups perform the actual noninvasive studies themselves at the patient bedside in unsterile surroundings. For the CL, CLR, EP and VIR groups roll task performance is centered on assisting with implantation and monitoring of delicate instruments placed in the patient's heart or intravascular space. For the ECHO, H/S and ECG groups roll task performance is defined by the application and use of sophisticated external probes and recording devices needed to perform the desired study. Practitioners from the CL, CLR, EP and VIR groups act as team members within a larger group structure, while CVT specialists from the ECHO, H/S and ECG groups usually perform their role tasks one-on-one with the patient and with more autonomy.

While other similarities exist between these groups of like practice, a relationship that connects the groups in a different way was also revealed. With the exception of VIR, the CL, CLR and EP invasive subspecialties in this survey defined roles that are more technically oriented and performed at arms length from the patient bedside. In contrast,

the VIR group described more patient centered roles, being in direct contact and having frequent communication with the client during role performance. This information was obtained earlier in the interviews and focus group meetings during survey development, but can also be further appreciated in survey outcomes as the CL and EP groups both rejected performance criteria related to maintaining a sterile field while the CL group rejected all key performance criteria related to assisting at the patient bedside. The CLR group had no comparable performance criteria assigned to it during survey development. These findings differentiate roll performance between the invasive subspecialties in a way that links aspects of VIR group practice to similarities in the non-invasive subspecialty areas.

The salient feature of most interest here is the relationship between the level of patient interaction during role performance and how the different groups scored the roll of health advocate and other aspects of patient interaction. While the VIR, ECHO, H/S and ECG groups scored high in the health advocate role retaining both performance criteria, they also scored high in core communicator roles related to introducing self, explaining procedure to patient and responding to patient concerns. In contrast, the CL, CLR and EP groups all scored low in the health advocate roll rejecting one of two performance criteria. Moreover, these groups also scored lower in the patient oriented communicator rolls with the CLR group requiring a consensus decision to retain the performance criteria related to self-introduction and procedural explanation. The CVT subspecialties from this research that identified with a high level of patient interaction during role performance scored higher in health advocacy and roles requiring communications with patients than those who identified with a lower level of patient interaction during role performance. Does the level of patient interaction during role performance influence individual self-awareness and attitude toward the role of health advocate? While it may be argued that health advocacy is or should be an important characteristic of all health professionals, this research proposes an interesting insight into elements that may help shape this facet of behavior in healthcare delivery. More research is needed to further explore the importance of these relationships and to what degree if any they may help the development and participation in health advocacy roles for better patient care. While efforts to define competency standards for this broad domain of practice will no doubt continue to progress, this study attempts to advance CVT curriculum reform initiatives by aligning such standards with the evidence-based CanMEDS framework⁶ and offers an example of how it might be used to define competencies for other allied health specialties. No published literature was found utilizing the CanMEDS framework for competency development in this domain, increasing the practical value of this study as it contributes to the development and reform of CVT

educational curricula aimed at improving learning outcomes using recognized standards of competence.

Study limitations

In addition to the small number of respondents and the limitations this imposes on interpreting results, another weakness may be the lack of an international consensus on competency development for this domain, which impacts generalizability of the research findings. One method to overcome this could include use of the Delphi technique within an international forum to help incorporate a broader view. This study does however include an international presence in its target population as well as material taken from international professional bodies that may help balance the effect of this weakness. Another shortcoming related to study design is the scope of work the research attempted to undertake. This overambitious work could have more easily been completed if it were carried out as two separate projects for the invasive and noninvasive subspecialties alone if not one dedicated for each of the seven CVT technologies. The huge area of focus made it difficult to manage time and give fair treatment to all seven groups. As a result, this oversight in study design allowed whole areas of the task analysis for the ECHO and ECG subspecialties to be missed. In a rush to meet research deadlines, it was realized too late that important role performance criteria related to the identification of various anatomical features using ultrasound and the electrocardiographic detection of specific cardiac arrhythmias were conspicuously missing.

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Conflict of Interest

The author declares that he has no conflict of interest.

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Appendix

Proposed competency profile for the Cardiovascular Technology field (2011)

No	CL Competency Profile - Roll performance criteria	Role retain/reject	Response rate	
			routinely/ frequently	rarely/ never
1	Set up sterile trays in preparation for procedures	reject	7(6/1)	13(8/5)
2	Select appropriate equipment for procedure (e.g. catheter, Stent, Balloon ect)	expert (Key)	13(9/4)	7(5/2)
3	Perform or coordinate equipment calibration and troubleshooting.	manager (Core)	18(12/6)	2(1/1)
4	Verify equipment safety checks	manager (Core)	18(14/4)	2(1/1)
5	Introduce self & explain procedure to patient	communicator (Core)	11(4/7)	9(5/4)
6	Appropriately respond to patient's questions or concerns	communicator (Core)	11(4/7)	9(5/4)
7	Assist physician at table during angioplasty	reject	7(5/2)	13(3/10)
8	Assist physician at table during valvuloplasty	reject	7(5/2)	13(3/10)
9	Assist physician at table during coronary angiogram	reject	7(5/2)	13(3/10)
10	Assist physician at table during pediatric device placement	reject	5(4/1)	15(4/11)
11	Assist physician at table during pacemaker/AICD insertion	reject	7(6/1)	13(4/9)
12	Assist with intravascular ultrasound (IVUS) procedure	expert (Key)	15(11/4)	5(4/1)
13	Assist with pressure wire measurement (flow fraction rate)	expert (Key)	16(12/4)	4(4/0)
14	Perform quantitative coronary analysis (QCA) to determine vessel length, caliber and lesion area	expert (Key)	13(7/6)	7(6/1)
15	Measure valve area using hemodynamic studies	expert (Key)	16(11/5)	4(2/2)
16	Monitor and record patient physiological parameters during procedures	communicator (Core)	19(19/0)	1(1/0)
17	Communicate patient parameters and abnormal events to appropriate staff	communicator (Core)	19(19/0)	1(1/0)
18	Communicate within your department to relay important information	collaborator (Core)	19(16/3)	1(0/1)
19	Communicate with other Departments to relay important information	collaborator (Core)	15(7/8)	5(4/1)
20	Document and archive relevant patient information	communicator (Core)	20(19/1)	0(0/0)
21	Use appropriate medical terminology in written and verbal communication	communicator (Core)	20(19/1)	0(0/0)
22	Provide information willingly to educate and promote the patient's health and well-being	health advocate (Core)	11(2/9)	9(7/2)
23	Take affirmative action to promote health needs that are in the patient's best interest	reject	7(1/6)	13(11/2)
24	Review Department policies & procedures	professional (Core)	18(10/8)	2(2/0)
25	Use professional judgment to identify contraindications to procedure and take appropriate action	professional (Core)	15(14/1)	5(5/0)
26	Demonstrate professional conduct in appearance, communication and action	professional (Core)	20(19/1)	0(0/0)
27	Demonstrate reliability, flexibility and adaptability in clinical practice	professional (Core)	20(19/1)	0(0/0)
28	Maintain patient privacy and confidentiality	professional (Core)	20(19/1)	0(0/0)
29	Demonstrate awareness and sensitivity to patient's cultural and gender-specific needs	professional (Core)	20(19/1)	0(0/0)
30	Apply aseptic technique and infection control policy and procedures	expert (Core)	16(8/8)	4(4/0)
31	Participate in continuing education activities to maintain clinical knowledge, skills and attitudes appropriate for practice	scholar (Core)	13(3/10)	7(6/1)
32	Understand research methodology and how to apply it	scholar (Core)	11(3/8)	9(8/1)
33	Order consumable supplies and use resources efficiently to promote optimal department function	manager (Core)	19(13/6)	1(1/0)
34	Maintain certification in Basic Life Support (BLS)	expert (Core)	20(20/0)	0(0/0)

No	EP Competency Profile - Roll performance criteria	Role retain/reject	Response rate	
			routinely/ frequently	rarely/ never
1	Set up sterile trays in preparation for procedures	reject	1(0/1)	4(1/3)
2	Select appropriate equipment for procedure (e.g. ablation catheter, mapping catheter)	expert (Key)	5(3/2)	0(0/0)
3	Perform or coordinate equipment calibration and troubleshooting	manager (Core)	5(3/2)	0(0/0)
4	Verify equipment safety checks	manager (Core)	5(3/2)	0(0/0)
5	Introduce self & explain procedure to patient	communicator (Core)	3(2/1)	2(2/0)
6	Appropriately respond to patient's questions or concerns	communicator (Core)	3(2/1)	2(2/0)
7	Assist physician during EP mapping	expert (Key)	5(4/1)	0(0/0)
8	Assist physician during catheter ablation	expert (Key)	5(4/1)	0(0/0)
9	Assist physician during tilt table test	expert (Key)	5(4/1)	0(0/0)

10	Assist physician during pacemaker insertion	expert (Key)	5(3/2)	0(0/0)
11	Assist physician during Automated Implantable Cardiac Defibrillator (AICD/ ICD) insertion	expert (Key)	5(3/2)	0(0/0)
12	Assist Physician during pacemaker clinic	expert (Key)	5(4/1)	0(0/0)
13	Perform non-contact 3D EP mapping (endocardial solution)	expert (Key)	4(3/1)	1(0/1)
14	Perform electro-anatomical mapping	expert (Key)	4(3/1)	1(0/1)
15	Monitor and record patient physiological parameters during procedures	communicator (Core)	5(4/1)	0(0/0)
16	Communicate patient parameters and abnormal events to appropriate staff	communicator (Core)	5(5/0)	0(0/0)
17	Communicate within your department to relay important information	collaborator (Core)	5(5/0)	0(0/0)
18	Communicate with other Departments to relay important information	collaborator (Core)	2(2/0)	2(2/0)
19	Document and archive relevant patient information	communicator (Core)	5(5/0)	0(0/0)
20	Use appropriate medical terminology in written and verbal communication	communicator (Core)	5(5/0)	0(0/0)
21	Provide information willingly to educate and promote the patient's health and well-being	health advocate (Core)	3(3/0)	2(2/0)
22	Take affirmative action to promote health needs that are in the patient's best interest	reject	1(0/1)	4(4/0)
23	Review Department policies & procedures	professional (Core)	5(3/2)	0(0/0)
24	Use professional judgment to identify contraindications to procedure and take appropriate action	professional (Core)	4(3/1)	1(1/0)
25	Demonstrate professional conduct in appearance, communication and action	professional (Core)	5(5/0)	0(0/0)
26	Demonstrate reliability, flexibility and adaptability in clinical practice	professional (Core)	5(5/0)	0(0/0)
27	Maintain patient privacy and confidentiality	professional (Core)	5(5/0)	0(0/0)
28	Demonstrate awareness and sensitivity to patient's cultural and gender-specific needs	professional (Core)	5(5/0)	0(0/0)
29	Apply aseptic technique and infection control policy and procedures	expert (Core)	5(3/2)	0(0/0)
30	Participate in continuing education activities to maintain clinical knowledge, skills and attitudes appropriate for practice	scholar (Core)	4(1/3)	1(0/1)
31	Understand research methodology and how to apply it	reject	1(0/1)	4(2/2)
32	Order consumable supplies and use resources efficiently to promote optimal department function	manager (Core)	4(3/1)	1(1/0)
33	Maintain certification in Basic Life Support (BLS)	expert (Core)	5(5/0)	0(0/0)

No	CLR Competency Profile - Roll performance criteria	Role retain/reject	Response rate	
			routinely/ frequently	rarely/ never
1	Verify equipment safety checks	manager (Core)	5(5/0)	0(0/0)
2	Perform or coordinate equipment calibration and troubleshooting	manager (Core)	5(3/2)	0(0/0)
3	Coordinate periodical x-ray emissions calibration	manager (Key)	5(3/2)	0(0/0)
4	Use and maintain x-ray safety equipment (thyroid shield & lead apron) during procedures	manager (Key)	5(5/0)	0(0/0)
5	Monitor & record radiation exposure and ensure proper use of radiation badges	manager (Key)	5(5/0)	0(0/0)
6	Set up injector and load contrast prior to procedure	expert (Key)	5(2/3)	0(0/0)
7	Introduce self & explain procedure to patient	communicator (Core)	2(1/1)	2(2/0)
8	Appropriately respond to patient's questions or concerns	communicator (Core)	3(1/2)	2(2/0)
9	Operate Bi-Plane or Single-Plane X-ray equipment	expert (Key)	4(3/1)	1(1/0)
10	Adjust X-ray table during contrast injection	expert (Key)	4(3/1)	1(0/1)
11	Communicate within your department to relay important information	collaborator (Core)	5(3/2)	0(0/0)
12	Communicate with other Departments to relay important information	collaborator (Core)	2(1/1)	2(2/0)
13	Document and archive relevant patient information	communicator (Core)	5(4/1)	0(0/0)
14	Use appropriate medical terminology in written and verbal communication	communicator (Core)	5(5/0)	0(0/0)
15	Provide information willingly to educate and promote the patient's health and well-being	health advocate (Core)	3(2/1)	2(2/0)
16	Take affirmative action to promote health needs that are in the patient's best interest	reject	1(0/1)	4(3/1)
17	Review Department policies & procedures	professional (Core)	5(3/2)	0(0/0)
18	Use professional judgment to identify contraindications to procedure and take appropriate action	professional (Core)	5(4/1)	0(0/0)
19	Demonstrate professional conduct in appearance, communication and action	professional (Core)	5(5/0)	0(0/0)
20	Demonstrate reliability, flexibility and adaptability in clinical practice	professional (Core)	5(4/1)	0(0/0)
21	Maintain patient privacy and confidentiality	professional (Core)	5(5/0)	0(0/0)
22	Demonstrate awareness and sensitivity to patient's cultural and gender-specific needs	professional (Core)	5(5/0)	0(0/0)
23	Apply aseptic technique and infection control policy and procedures	expert (Core)	4(3/1)	1(1/0)
24	Participate in continuing education activities to maintain clinical knowledge, skills and attitudes appropriate for practice	scholar (Core)	4(3/1)	1(1/0)
25	Understand research methodology and how to apply it	reject	1(1/0)	4(2/2)
26	Order consumable supplies and use resources efficiently to promote optimal department function	reject	1(1/0)	4(3/1)
27	Maintain certification in Basic Life Support (BLS)	expert (Core)	5(5/0)	0(0/0)

No	VIR Competency Profile - Roll performance criteria	Role retain/reject	Response rate	
			routinely/ frequently	rarely/ never
1	Set up sterile trays in preparation for procedures	expert (Key)	12(6/6)	1(1/0)
2	Set up embolization material	expert (Key)	12(5/7)	1(0/1)
3	Select and prepare appropriate equipment for procedure (e.g. catheter, balloon, sheath)	expert (Key)	11(5/6)	2(2/0)
4	Perform or coordinate equipment calibration and troubleshooting	manager (Core)	13(10/3)	0(0/0)
5	Verify equipment safety checks	manager (Core)	13(9/4)	0(0/0)
6	Inform Biomedical Engineering of any equipment failures	manager (Key)	13(11/2)	0(0/0)
7	Coordinate periodical x-ray emissions calibration	manager (Key)	12(8/4)	1(0/1)
8	Introduce self & explain procedure to patient	communicator (Core)	13(12/1)	0(0/0)

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9	Appropriately respond to patient's questions or concerns	communicator (Core)	13(12/1)	0(0/0)
10	Prepare patient for procedure	expert (Key)	13(11/2)	0(0/0)
11	Use and maintain x-ray safety equipment (thyroid shield & lead apron) during procedures	manager (Key)	13(13/0)	0(0/0)
12	Monitor & record radiation exposure and ensure proper use of radiation badges	manager (Key)	13(13/0)	0(0/0)
13	Operate Bi-Plane or Single-Plane X-ray equipment	expert (Key)	13(7/6)	0(0/0)
14	Operate digital subtraction angiography equipment	expert (Key)	13(12/1)	0(0/0)
15	Operate contrast power injectors	expert (Key)	13(13/0)	0(0/0)
16	Operate vessel measurement equipment	expert (Key)	13(12/1)	0(0/0)
17	Assist physician at table during angiography/angioplasty	expert (Key)	13(12/1)	0(0/0)
18	Assist physician at table during Embolization	expert (Key)	13(12/1)	0(0/0)
19	Assist physician at table during Radio-frequency Ablation (RFA)	expert (Key)	12(12/0)	1(1/0)
20	Assist physician at table during tissue biopsy	expert (Key)	12(12/0)	1(1/0)
21	Assist physician at table during sclerotherapy	expert (Key)	12(12/0)	1(1/0)
22	Assist physician at table with fluid drainage procedures (abscess, pleural effusion)	expert (Key)	12(12/0)	1(1/0)
23	Monitor and record patient physiological parameters during procedures	communicator (Core)	10(10/0)	3(3/0)
24	Communicate patient parameters and abnormal events to appropriate staff	communicator (Core)	10(8/2)	3(3/0)
25	Communicate within your department to relay important information	collaborator (Core)	11(11/0)	2(2/0)
26	Communicate with other Departments to relay important information	collaborator (Core)	11(5/6)	2(2/0)
27	Document and archive relevant patient information	communicator (Core)	12(11/1)	1(1/0)
28	Use appropriate medical terminology in written and verbal communication	communicator (Core)	13(12/1)	0(0/0)
29	Provide information willingly to educate and promote the patient's health and well-being	health advocate (Core)	11(10/1)	2(2/0)
30	Take affirmative action to promote health needs that are in the patient's best interest	health advocate (Core)	10(7/3)	3(2/1)
31	Review Department policies & procedures	professional (Core)	12(10/2)	1(1/0)
32	Use professional judgment to identify contraindications to procedure and take appropriate action	professional (Core)	13(12/1)	0(0/0)
33	Demonstrate professional conduct in appearance, communication and action	professional (Core)	13(13/0)	0(0/0)
34	Demonstrate reliability, flexibility and adaptability in clinical practice	professional (Core)	13(13/0)	0(0/0)
35	Maintain patient privacy and confidentiality	professional (Core)	13(13/0)	0(0/0)
36	Demonstrate awareness and sensitivity to patient's cultural and gender-specific needs	professional (Core)	13(12/1)	0(0/0)
37	Apply aseptic technique and infection control policy and procedures	expert (Core)	13(13/0)	0(0/0)
38	Participate in continuing education activities to maintain clinical knowledge, skills and attitudes appropriate for practice	scholar (Core)	13(10/3)	0(0/0)
39	Understand research methodology and how to apply it	scholar (Core)	10(2/8)	3(3/0)
40	Order consumable supplies and use resources efficiently to promote optimal department function	manager (Core)	13(8/5)	0(0/0)
41	Maintain certification in Basic Life Support (BLS)	expert (Core)	13(13/0)	0(0/0)

No	ECHO Competency Profile - Roll performance criteria	Role retain/reject	Response rate	
			routinely/ frequently	rarely/ never
1	Review patient chart and confirm physician orders	collaborator (Key)	19(17/2)	6(0/6)
2	Set up ECHO equipment and select appropriate probes	expert (Key)	24(22/2)	1(1/0)
3	Perform or coordinate equipment calibration and troubleshooting	manager (Core)	17(13/4)	8(3/5)
4	Verify equipment safety checks	manager (Core)	20(15/5)	5(2/3)
5	Introduce self & explain procedure to patient	communicator (Core)	21(17/4)	4(3/1)
6	Appropriately respond to patient's questions or concerns	communicator (Core)	21(17/4)	4(3/1)
7	Prepare patient for procedure	expert (Key)	23(22/1)	2(1/1)
8	Use correct orientation of transducer	expert (Key)	25(24/1)	0(0/0)
9	Perform ECHO procedure using M-Mode	expert (Key)	25(24/1)	0(0/0)
10	Perform ECHO procedure using 2D ECHO	expert (Key)	25(25/0)	0(0/0)
11	Perform ECHO procedure using 3D ECHO	reject	8(4/4)	17(11/6)
12	Perform ECHO procedure using pulse and continuous wave doppler	expert (Key)	25(24/1)	0(0/0)
13	Perform ECHO using tissue doppler	expert (Key)	24(22/2)	1(1/0)
14	Assist physician with Trans-Esophageal ECHO (TEE)	expert (Key)	18(14/4)	7(1/6)
15	Assist physician during exercise stress ECHO (treadmill)	expert (Key)	14(12/2)	11(2/9)
16	Assist physician during pharmacological stress ECHO (thallium & dobutamine)	expert (Key)	17(13/4)	8(2/6)
17	Perform TEE probe disinfection and cleaning. Identified as missing from task analysis	manager (Key)	-----	-----
18	Perform calculations manually and while using software packages	expert (Key)	20(15/5)	5(2/3)
19	Correlate results with findings from other medical investigations	expert (Key)	17(13/4)	8(3/5)
20	Perform interpretation of ECHO findings	communicator (Key)	16(10/6)	9(4/5)
21	Communicate patient parameters and abnormal events to appropriate staff	communicator (Core)	25(24/1)	0(0/0)
22	Communicate within your department to relay important information	collaborator (Core)	18(13/5)	7(1/6)
23	Communicate with other Departments to relay important information	collaborator (Core)	16(6/10)	9(3/6)
24	Document and archive relevant patient information	communicator (Core)	20(18/2)	5(1/4)
25	Use appropriate medical terminology in written and verbal communication	communicator (Core)	25(25/0)	0(0/0)
26	Provide information willingly to educate and promote the patient's health and well-being	health advocate (Core)	14(12/2)	11(2/9)
27	Take affirmative action to promote health needs that are in the patient's best interest	health advocate (Core)	13(11/2)	12(3/9)
28	Review Department policies & procedures	professional (Core)	16(8/8)	9(6/3)
29	Use professional judgment to identify contraindications to procedure and take appropriate action	professional (Core)	20(18/2)	5(1/4)
30	Demonstrate professional conduct in appearance, communication and action	professional (Core)	25(25/0)	0(0/0)
31	Demonstrate reliability, flexibility and adaptability in clinical practice	professional (Core)	25(24/1)	0(0/0)

32	Maintain patient privacy and confidentiality	Core (professional)	25(25/0)	0(0/0)
33	Demonstrate awareness and sensitivity to patient's cultural and gender-specific needs	professional (Core)	25(25/0)	0(0/0)
34	Apply aseptic technique and infection control policy and procedures	expert (Core)	25(24/1)	0(0/0)
35	Participate in continuing education activities to maintain clinical knowledge, skills and attitudes appropriate for practice	scholar (Core)	16(6/10)	9(5/4)
36	Understand research methodology and how to apply it	reject	8(1/7)	17(10/7)
37	Order consumable supplies and use resources efficiently to promote optimal department function	manager (Core)	13(5/8)	12(4/8)
38	Maintain certification in Basic Life Support (BLS)	expert (Core)	25(24/1)	0(0/0)

No	H/S Competency Profile - Roll performance criteria	Role retain/reject	Response rate	
			routinely/ frequently	rarely/ never
1	Review patient chart and confirm physician orders	collaborator (Key)	5(5/0)	0(0/0)
2	Set up and program Holter / Stress equipment	expert (Key)	5(3/2)	0(0/0)
3	Perform or coordinate equipment calibration and troubleshooting	manager (Core)	5(0/5)	0(0/0)
4	Verify equipment safety checks	manager (Core)	5(2/3)	0(0/0)
5	Introduce self & explain procedure to patient	communicator (Core)	5(4/1)	0(0/0)
6	Appropriately respond to patient's questions or concerns	communicator (Core)	5(4/1)	0(0/0)
7	Provide patient with Holter device training	communicator (Key)	5(4/1)	0(0/0)
8	Retrieve and download Holter study data	communicator (Key)	5(5/0)	0(0/0)
9	Perform basic Interpretation of Holter study (arrhythmia type & duration)	expert (Key)	5(4/1)	0(0/0)
10	Recognize recording errors /artifacts	expert (Key)	5(4/1)	0(0/0)
11	Prepare patient for stress test	expert (Key)	5(5/0)	0(0/0)
12	Monitor and record patient physiological parameters during procedures	communicator (Core)	5(5/0)	0(0/0)
13	Communicate patient parameters and abnormal events to appropriate staff	communicator (Core)	5(5/0)	0(0/0)
14	Communicate within your department to relay important information	collaborator (Core)	5(4/1)	0(0/0)
15	Communicate with other Departments to relay important information	reject	2(1/1)	3(3/0)
16	Document and archive relevant patient information	communicator (Core)	5(4/1)	0(0/0)
17	Use appropriate medical terminology in written and verbal communication	communicator (Core)	5(5/0)	0(0/0)
18	Provide information willingly to educate and promote the patient's health and well-being	health advocate (Core)	5(4/1)	0(0/0)
19	Take affirmative action to promote health needs that are in the patient's best interest	health advocate (Core)	3(1/2)	2(2/0)
20	Review Department policies & procedures	professional (Core)	5(3/2)	0(0/0)
21	Use professional judgment to identify contraindications to procedure and take appropriate action	professional (Core)	5(4/1)	0(0/0)
22	Demonstrate professional conduct in appearance, communication and action	professional (Core)	5(5/0)	0(0/0)
23	Demonstrate reliability, flexibility and adaptability in clinical practice	professional (Core)	5(5/0)	0(0/0)
24	Maintain patient privacy and confidentiality	professional (Core)	5(5/0)	0(0/0)
25	Demonstrate awareness and sensitivity to patient's cultural and gender-specific needs	professional (Core)	5(5/0)	0(0/0)
26	Apply aseptic technique and infection control policy and procedures	Expert (Core)	5(5/0)	0(0/0)
27	Participate in continuing education activities to maintain clinical knowledge, skills and attitudes appropriate for practice	scholar (Core)	5(4/1)	0(0/0)
28	Understand research methodology and how to apply it	reject	0(0/0)	5(5/0)
29	Order consumable supplies and use resources efficiently to promote optimal department function	manager (Core)	4(4/0)	1(0/1)
30	Maintain certification in Basic Life Support (BLS)	expert (Core)	5(5/0)	0(0/0)

No	ECG Competency Profile - Roll performance criteria	Role retain/reject	Response rate	
			routinely/ frequently	rarely/ never
1	Review patient chart and confirm physician orders	collaborator (Key)	7(3/4)	5(4/1)
2	Set up ECG equipment and select appropriate leads	expert (Key)	12(12/0)	0(0/0)
3	Perform or coordinate equipment calibration and troubleshooting	manager (Core)	8(3/5)	4(4/0)
4	Verify equipment safety checks	manager (Core)	8(4/4)	4(4/0)
5	Introduce self & explain procedure to patient	communicator (Core)	11(10/1)	1(1/0)
6	Appropriately respond to patient's questions or concerns	communicator (Core)	12(10/2)	0(0/0)
7	Prepare patient for procedure	expert (Key)	12(12/0)	0(0/0)
8	Perform standard 12-Lead ECG	expert (Key)	12(11/1)	0(0/0)
9	Perform 15-Lead pediatric ECG (0 to 8 years)	expert (Key)	10(10/0)	2(1/1)
10	Perform basic interpretation of ECG study (arrhythmia type & duration)	expert (Core)	7(3/4)	5(5/0)
11	Recognize recording errors /artifacts	expert (Key)	12(11/1)	0(0/0)
12	Communicate patient parameters and abnormal events to appropriate staff	communicator (Core)	12(11/1)	0(0/0)
13	Communicate within your department to relay important information	collaborator (Core)	12(9/3)	0(0/0)
14	Communicate with other Departments to relay important information	collaborator (Core)	8(2/6)	4(3/1)
15	Document and archive relevant patient information	communicator (Core)	12(10/2)	0(0/0)
16	Use appropriate medical terminology in written and verbal communication	communicator (Core)	12(12/0)	0(0/0)
17	Provide information willingly to educate and promote the patient's health and well-being	health advocate (Core)	8(2/6)	4(3/1)
18	Take affirmative action to promote health needs that are in the patient's best interest	health advocate (Core)	7(3/4)	5(5/0)
19	Review Department policies & procedures	professional (Core)	11(8/3)	1(1/0)
20	Use professional judgment to identify contraindications to procedure and take appropriate action	professional (Core)	7(3/4)	5(5/0)
21	Demonstrate professional conduct in appearance, communication and action	professional (Core)	12(12/0)	0(0/0)

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22	Demonstrate reliability, flexibility and adaptability in clinical practice	professional (Core)	12(10/2)	0(0/0)
23	Maintain patient privacy and confidentiality	professional (Core)	12(12/0)	0(0/0)
24	Demonstrate awareness and sensitivity to patient's cultural and gender-specific needs	professional (Core)	12(12/0)	(0/0)
25	Apply aseptic technique and infection control policy and procedures	Expert (Core)	(10/2)	0(0/0)
26	Participate in continuing education activities to maintain clinical knowledge, skills and attitudes appropriate for practice	scholar (Core)	9(3/6)	3(3/0)
27	Understand research methodology and how to apply it	reject	5(1/4)	7(2/5)
28	Order consumable supplies and use resources efficiently to promote optimal department function	manager (Core)	11(6/5)	1(1/0)
29	Maintain certification in Basic Life Support (BLS)	expert (Core)	12(12/0)	0(0/0)
