Difficulty and Controversy in Training NMT Students in In Vitro Techniques

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Objective: In vitro nuclear medicine training is a requirement in the *Essentials and Guidelines* for an accredited nuclear medicine technology (NMT) training program. The guidelines are somewhat vague as to how this training should be accomplished. Our goal was to determine how other NMT programs were fulfilling the in vitro techniques training requirement.
Methods: A survey was developed and sent to 121 accredited NMT programs in the US.
Results: Didactic instruction provided ranges from 2–90 hr. Benchwork experience varies from 0–240 hr. Although the majority of programs provide didactic instruction and benchwork experience, it is often done with difficulty.
Conclusions: Considering the disparate results and survey comments, the accrediting agency needs to review and clarify the need for this curriculum essential.
Key Words: in vitro techniques; nuclear medicine technologist training

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The 1991 revision of the *Essentials and Guidelines for an Accredited Educational Program for the Nuclear Medicine Technologist* (*1*) states that the curriculum must include in vitro techniques. On page 9 of the *Essentials and Guidelines* the curriculum is described as including both classroom instruction and supervised clinical experience. The specific content for nuclear medicine in vitro procedures found on page 10 of the *Essentials and Guidelines* is:

a. Principles of immunology including methodology and quality of competitive binding and receptor procedures;
b. Radioimmunoassay technology including preparation of radioligands;
c. Operation of laboratory instruments and equipment such as pipettes, centrifuges, pH meters, analytical balances and multisample gamma and beta scintillation counters; and
d. Management of toxic chemicals and infectious biologic and radioactive materials.

The current revision of the *Essentials and Guidelines* does not require a minimum number of benchwork hours of in vitro techniques. Before 1991 a minimum of 160 benchwork hours was required.

In our program at the State University of New York (SUNY) at Buffalo, we define nuclear medicine in vitro procedures to be radioimmunoassays (RIAs) and related laboratory techniques in both the didactic and laboratory disciplines. Procedures such as blood volumes, Schilling test, and thyroid uptake are defined as nonimaging in vivo studies both in our curriculum and in the *Essentials and Guidelines*. For these studies the patient receives a radiopharmaceutical, therefore obtaining some radiation exposure as with in vivo imaging studies. Furthermore, the dynamics of the test take place within the patient's body adding credence to the classification of the testing as in vivo.

In vitro testing, based on immunological principles, is currently one of the most important technologies for investigation and detection of disease. For many years RIA (competitive assay based on radioactively labeled tracer) was unbeatable for assay precision, sensitivity and specificity. Immunoradiometric assays (IRMA), immunometric/sandwich assays using radioactively-labeled tracer, went a step further to provide increased sensitivity and precision at lower concentrations of ligand plus offering a wider diagnostic range. Traditionally, testing using radioisotopes was performed by a dedicated group of professionals in RIA laboratories set apart from routine clinical laboratories. Some of the disadvantages of performing immunoassays using radioactive labels are the short shelf life of reagents, the difficulty in handling and disposing of reagents, the requirement for expensive capital equipment and the need for specialized staff to perform the assays (*2*).

Since the 1970s immunoassay methods have been increasing in use and development as an analytic technique in basic science as well as in clinical laboratory medicine. Nonisotopic immunoassays have the advantage of ease of performance in a routine clinical laboratory and offer longer shelf life (*3*). Recent developments have led to improved sensitivity, reliability

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TABLE 1
CAP Test Results for Survey KB (Ligands I)

	1986			1990			1994		
Assay	Total participants	Isotopic method	%	Total participants	Isotopic method	%	Total participants	Isotopic method	%
CEA	1187	284	23.9	1002	166	16.6	1688	70	4.1
Cortisol	1373	957	69.7	1209	420	34.8	1212	286	23.6
Ferritin	1112	797	71.7	1307	440	33.7	2047	138	6.7
Folic acid*	1366	1361	99.6	1093	1086	99.4	1260	646	51.3
T-3 uptake	1683	1271	75.5	1172	592	50.5	1002	198	19.8
T-3	909	890	97.9	825	563	68.2	1020	255	25.0
T-4	1823	1354	74.3	1614	623	38.6	1836	205	11.2
Free T-4	415	403	97.1	422	258	61.1	1023	152	14.9
TSH	1761	1432	81.3	1847	788	42.7	2381	234	9.8
Vitamin B-12*	1363	1354	99.3	1098	1079	98.3	1463	623	42.5

*A number of nonisotopic methods for determining folic acid and vitamin B12 have been developed and submitted to the FDA for approval during the past 2 to 3 years.

and convenience of immunoassay (*4*). The performance characteristics of nonisotopic immunoassays are equal to or greater than the traditional RIA methods.

RIAs can be semi-automated using robotic samplers and multiwell counters. Total automation of immunoassays did not become successful until nonisotopic systems, such as enzyme and fluorescent immunoassay, became available. Automation is highly desirable since it improves the efficiency of the laboratory, reduces labor intensive procedures, reduces turn-around time and lends itself to point-of-care testing. The trend to automate immunoassay tests is certain to continue, reducing labor costs and skill level of operators. Decreasing turn-around time and being able to offer more tests on fewer analyzers will increase the overall efficiency of the laboratory. There will be a continued move away from using radioisotopes because of the cost and restrictions associated with disposal (*5*).

Endocrine testing, specifically thyroid testing which has been traditionally associated with nuclear medicine, has gone the way of nonisotopic automated immunoassay and is being performed in clinical laboratories (*6*). A review of the College of American Pathologists (CAP) proficiency test survey KB clearly shows that RIA and related techniques are being replaced with nonisotopic immunoassays. Table 1 lists the CAP survey results for the tests most closely associated with in vitro nuclear medicine.

In Buffalo, New York, the only nuclear medicine department that continues to do in vitro techniques is the Department of Veterans Affairs Medical Center (DVAMC). At present within the Department of Veterans Affairs, there are 139 medical centers that offer nuclear medicine services. From DVA Central Office we were able to obtain a list of the nuclear medicine services performing RIA and related techniques. The list compiled in 1991 included 44 medical centers.

The 44 medical centers were surveyed for their current status on RIA. Thirty-eight responded, of which 29 are still performing in vitro techniques. Therefore, we can say that approximately 21% (29 of 139) of DVAMC Nuclear Medicine Services are performing RIA.

In 19 of 29 DVAMC facilities performing in vitro techniques, the work is performed exclusively by nuclear medicine technologists (NMTs). In the other 10 facilities, the work is performed by both NMTs and medical technologists (MTs) or exclusively by MTs. Additionally, 8 of 23 of the facilities indicated that they also perform nonisotopic assays within the nuclear medicine service.

The DVAMC is the only clinical site available for training students in in vitro techniques in the Buffalo area. The university purchases the kits and other supplies for the students to use during this clinical rotation. The DVAMC provides the laboratory space, the use of their equipment, and their staff for in vitro training. Our NMT program recently lost the key faculty person in the area of RIA and related techniques. The expense of providing the training and the difficulty in scheduling has lead us to question the need to provide the RIA portion of the curriculum since it is seldom used in an NMT's career. Few, if any, of our SUNY at Buffalo program graduates have obtained jobs where they have been required to perform in vitro techniques.

As we reviewed our curriculum, we wanted to know how other NMT training programs were fulfilling the in vitro techniques requirement of the *Essentials and Guidelines*. We developed a survey for that purpose which was sent to all of the 121 accredited programs.

MATERIALS AND METHODS

We designed a survey to provide us with information on how and to what extent other NMT training programs provided instruction in RIA and related techniques. The specific objectives of our survey included determining:

1. How many lecture hours are spent on the basic principles of RIA and related techniques (including basic

TABLE 2
Lecture Hours Spent on Basic Test Principles

Lecture hours spent on basic principles of RIA, related techniques and assay methods:

	All programs (73 respondents)	BS programs (25 respondents)
Median	9.0	10.0
Average	11.7	10.5
Range	0–50	0–45

Assay methods covered in lecture:

	All programs (73 respondents)		BS programs (25 respondents)	
Method	**No.**	**%**	**No.**	**%**
RIA	70	96	24	96
IRMA	50	68	18	72
ELISA	21	29	10	40
EIA/FIA	23	32	12	48
CHEMI	15	21	6	24
Other*	8	11	7	28

*MEIA, FPIA, CPB, ION CAPTURE, CBR, competitive inhibition RIA, and quantitative marker assay.

TABLE 3
Lecture Hours Spent on Specific Clinical Assays

Lecture hours on specific clinical assays:

	All programs (73 respondents)	BS programs (25 respondents)
Median	5	5
Average	7.4	8.2
Range	0–40	0–30

Specific tests covered in lecture:

	All programs (73 respondents)		BS programs (25 respondents)	
Test	**No.**	**%**	**No.**	**%**
Thyroid functions	65	89	23	92
Vitamin B-12 and Folate	57	78	19	76
Digoxin	41	56	18	72
Cortisol	29	40	14	56
Ferritin	26	36	14	56
Hepatitis B	38	52	18	72
Tumor markers	39	53	17	68
Gastrin	23	32	10	40
Parathyroid	29	40	11	44
Aldosterone	21	29	9	36
Plasma renin	24	33	11	44
B-HCG	27	37	13	52
Testosterone	28	38	14	56
Other*	15	21	6	24

*Gentamicin, tobramyacin, FSH, LH, MS-AFP, growth hormone, calcitonin, CRB, myoglobin, theophylline, dilantin, estradiol, progesterone, CA 125, PAP, estrogen, oxytocin, methotrexate, CEA, ACTH, insulin, HCG, prolactin, and hepatitis A and C.

immunology, antisera production, standards and tracer preparation, separation methods, data reduction and quality control).

2. Which assay methods are covered in lecture (RIA, IRMA, ELISA, EIA/FIA, Chemiluminescence, etc.).
3. How many lecture hours are devoted to specific clinical assays (e.g., organ system-specific tests such as thyroid, tumor markers, therapeutic drug monitoring tests, etc).
4. Which specific tests are covered in lecture.
5. How many lecture hours total are spent on in vitro procedures.
6. Who presents the didactic lectures on in vitro techniques.
7. What reference material do the students use in the study of in vitro techniques.
8. Where do students obtain practical in vitro experience.
9. How many hours each student spends (on campus and/or at a clinical site) performing in vitro techniques and what is covered.
10. Which kits or tests students actually perform and by which methodology.
11. What it costs per student for supplies specific to in vitro techniques (test tubes, kits, reagents, controls, new pipettes, tips, gloves, etc.).
12. What percentage of program graduates in the last five years have obtained jobs where the in vitro techniques training is utilized.

The survey was sent out in the fall of 1994 to all 121 accredited programs on the May 11, 1994 listing from the Joint Review Committee on Educational Programs in Nuclear Medicine Technology (JRCNMT). Since we offer a baccalaureate degree in NMT, the surveys were coded to distinguish the BS degree offering programs from the others for data tabulation purposes. Thirty-five of 121 programs surveyed offer a BS degree.

RESULTS

Of the 121 surveys sent out, 73 (60%) were returned. Twenty-five of 35 (71%) surveys sent to programs offering a BS degree were returned. The results stated in this paper pertain to the 73 total surveys returned. All tables include the comparison of BS degree programs with the total surveys returned. There is no apparent difference between the response from the BS programs and all programs.

On average, 11.7 lecture hr are spent on the basic principles of RIA, related techniques and other assay methods. The various assay methods and frequency covered are listed in Table 2. Lecture hours spent on specific clinical assays average 7.4 hr. The specific tests covered in lecture are listed in Table 3. On average 18.9 lecture hr are spent on in vitro methods and

TABLE 4
Total Lecture Hours Spent on In Vitro Procedures

Total lecture hours:

	All programs (73 respondents)	BS programs (25 respondents)
Median	15	15
Average	18.9	17.8
Range	2-90	5-45

Number of programs stating that the in vitro lecture hours include the nonimaging in vivo studies:

All programs (73 respondents)		BS programs (25 respondents)	
No.	%	No.	%
8	11	3	12

Number of programs stating that the in vitro lecture hours include radiolabeling of monoclonal antibody tumor imaging agents:

All programs (73 respondents)		BS programs (25 respondents)	
No.	%	No.	%
2	3	1	4

specific tests. However, some programs define in vitro to include the nonimaging in vivo studies and/or radiolabeling of monoclonal antibody tumor imaging agents. Table 4 describes the data collected on total lecture hours.

Didactic instruction in in vitro techniques is most often given by NMTs with greater than three years of experience in in vitro techniques. Some programs reported that their didactic instructors had little or no experience in this area. Table 5 expands on the profile of the in vitro techniques didactic instructor. A variety of reference materials is used for didactic instruction and is listed on Table 6.

Practical experience (i.e., benchwork hours) in in vitro techniques is provided for students in a variety of settings. Not all students in a program obtain their in vitro practical experience at the same clinical site. Many programs use more than one location for their students' in vitro benchwork experience. Twenty-seven percent of the programs provide some or all of the practical experience with mock labs on campus. Forty-nine percent of programs use nuclear medicine departments and 47% use clinical pathology laboratories for this training. Table 7 describes the location where practical experience is obtained and who supervises that training. Three programs commented that they anticipate losing their clinical affiliations, therefore would not be able to provide an in vitro technique clinical experience to their students in the future. Three programs commented that it is difficult to recruit clinical pathology departments to train NMTs because there is no benefit to the labs for providing the training.

TABLE 5
Profile of the In Vitro Techniques Didactic Instructor

Training	All programs (73 respondents) No.	%	BS programs (25 respondents) No.	%
NMT	55	75	21	84
MT	16	22	6	24

Years in vitro experience	All programs (73 respondents) No.	%	BS programs (25 respondents) No.	%
0	4	6	—	—
1–3	14	19	6	24
>3	55	75	19	76

Degree	All programs (73 respondents) No.	%	BS programs (25 respondents) No.	%
None	1	1	2	8
AS	5	7	13	52
BS	37	51	9	36
MS	20	27	4	16
PhD	10	14	3	12
MD	7	10	—	—

*Seven of the total programs (and five BS programs) listed two to three degrees for its teaching faculty, perhaps indicating that teaching is done by more than one person or that the instructor has more than one degree.

TABLE 6
Reference Material Used for Instruction*

Reference material	All programs (73 respondents) No.	%	BS programs (25 respondents) No.	%
None	2	3	1	4
Textbook chapters	59	81	20	80
Reprints	37	51	13	52
Articles	35	50	13	52
In-house text/ workbook	32	44	10	40
Other	4	6		
Video	1			
Slides	1			
Package inserts	2			

*Most programs indicated they used more than one source of reference materials.

TABLE 7
Location and Supervision of Practical Experience

	All programs (73 respondents)		BS programs (25 respondents)	
Location	No.	%	No.	%
Lab on campus	20	27	6	24
Nuc. med. dept.	36	49	18	72
Clinical laboratory	34	47	12	48
Other	2	3	1	4
Naval lab.	1		1	
Radiopharmacy	1			

*Many programs checked more than one; not all students obtain in vitro training at same location.

	All programs (73 respondents)		BS programs (25 respondents)	
Practical experience of supervisor	No.	%	No.	%
NMT	44	60	18	72
MT	33	45	10	40

Some programs do not appear to be providing their students with the practical experience in the use of basic laboratory equipment and skills as listed in the *Essentials and Guidelines*. Most programs provide students with pipetting experience. Table 8 describes the areas covered in in vitro techniques practical training. The survey did not ask if the specific equipment and skills in question were covered in other courses or any other non-RIA clinical experience.

Seven programs (10%) reported that their students receive no RIA practical experience, either by observation or hands on. The remaining programs provide an average of 54.1 benchwork hr of training. The benchwork hours provided by 11 (15%) programs were solely observation. Nine programs (12%) reported that their benchwork hours included Schilling tests, blood volumes, and related in vivo studies. Table 9 describes the range and scope of benchwork hours provided for NMT students.

TABLE 8
Areas Covered in Practical Training

	All programs (73 respondents)		BS programs (25 respondents)	
Training area	No.	%	No.	%
Pipetting	70	96	25	100
Centrifuges	68	93	24	96
pH meters	31	42	8	32
Balances	40	55	15	60
Liquid scintillation and QC	24	33	7	28
Gamma counter and QC	72	99	25	100
Phlebotomy	46	63	15	60
Blood/urine handling	68	93	23	92
Chemical safety	52	71	17	68
Radioactive disposal	68	93	23	92
Universal precautions	68	93	22	88

TABLE 9
Benchwork Hours

	All programs (73 respondents)		BS programs (25 respondents)	
Hours	No.	%	No.	%
0	7	10	0	—
1–20	19	26	3	12
21–40	26	36	12	48
41–80	8	11	4	16
81–160	11	15	4	16
161–240	2	3	2	8
Average*	54.1 hours		69 hours	

*The average is derived from the respondents that gave their students an in vitro clinical rotation, hands on or just observation.

Number of programs reporting that students obtain no RIA clinical training experience, observation and/or hands on:

All programs (73 respondents)		BS programs (25 respondents)	
No.	%	No.	%
7	10	—	—

Number of programs reporting that benchwork hours include observation only, no hands on:

All programs (73 respondents)		BS programs (25 respondents)	
No.	%	No.	%
11	15	1	4

Number of programs reporting that benchwork hours listed include Schilling test, blood volumes, and/or red cell survival/sequestration:

All programs (73 respondents)		BS programs (25 respondents)	
No.	%	No.	%
9	12	2	8

The tests/kits that students performed or observed most often are listed on Table 10. The survey also asked for the test/kit methodology (RIA, IRMA, ELISA, EIA/FIA, CHEMI, etc.). The frequency of methods observed or performed by students was actually of more interest. However, few programs provided this information.

Most programs that provided students with benchwork experience in in vitro techniques reported that the clinical sites absorbed the costs. Twelve programs (16%) reported the cost for this training for the 1993–1994 academic year. On average, that cost was $577 per program for the one year. The range of dollars spent by those programs was $40–$1,500.

On average, 14% of the program graduates in the last five years took a job in a nuclear medicine department that does in

TABLE 10
Test/Kits

Programs that marked "not applicable"* for tests/kits students perform or observe:

	All programs (73 respondents)		BS programs (25 respondents)	
	No.	%	No.	%
	21	29	3	12

*"Not applicable" indicates one of these: students do not do an RIA rotation or the person that filled out the survey does not know which tests the students are observing or performing.

	All programs† (52 respondents)		BS programs† (22 respondents)	
Test/Kit*	No.	%	No.	%
TSH	32	61	15	68
T-3	30	58	15	68
Free T-4	24	46	12	55
Total T-4	31	60	14	64
T-3 uptake	29	56	13	59
Hepatitis	13	25	7	32
Ferritin	16	31	10	46
Vitamin B-12	26	50	11	50
Folate	23	44	8	36
Cortisol	22	42	12	55
Digoxin	17	33	8	36
Tumor markers	13	25	6	27
Gastrin	12	23	6	27
Parathyroid	9	17	14	64
Aldosterone	4	8	2	9
Plasma renin	9	17	4	18
B-HCG	14	27	6	27
Testosterone	19	36	9	41

*31 other tests were listed also.

†Only 52 programs total (22 BS programs) provided information on which tests/kits students perform and/or observe.

vitro studies. The survey did not ask if the graduates are performing in vitro procedures. Also some programs, as previously stated, are defining the nonimaging in vivo studies as in vitro studies.

DISCUSSION

The survey comments were very enlightening. A sample of the comments can be found in Appendices 1 and 2. Appendix 1 lists some of the comments written in response to the question "Do you feel you are adequately covering the in vitro nuclear medicine aspects of the curriculum in terms of the JRCNMT *Essentials and Guidelines*?" A total of 16 surveys (22%) had the comment that RIA should be dropped as a requirement from the *Essentials and Guidelines*. Appendix 2 lists some of the other comments made by the program directors.

There is clearly confusion about the definition of nuclear medicine in vitro techniques and about what the JRCNMT expects in this area and why. Although the majority of programs provide didactic instruction and benchwork experience, it is often done with stress and resentment.

Outstanding comments include the following: it is difficult to teach an area that students will not need for employment or certification; it is very difficult to find facilities to take students; fewer and fewer nuclear medicine departments are doing RIA; and clinical pathology departments see no benefit in training NMTs.

Some program directors believe the JRCNMT has not dropped the in vitro techniques requirement from the curriculum because of the development of monoclonal antibody radiopharmaceuticals for therapy and diagnosis. Without question, an understanding of immunology should be part of an NMT curriculum. The study of immunoassays is another subject.

CONCLUSIONS

Didactic instruction ranged from 2–90 hr. Instruction is sometimes given by a person with little or no experience in in vitro techniques. Benchwork experience varies from 0–240 hr. Some program directors did not know which tests and/or methodologies their students were performing or observing during the clinical experience.

The decline in the use of radioisotopic in vitro techniques, the disparity in training provided and the comments made by the survey respondents suggests that the JRCNMT needs to address this issue. They need to review this essential and give guidelines for providing this training if it is not to be eliminated.

In light of the changing patterns of health care cost reimbursement, NMT program directors will have more pressing concerns in the next several years. In vitro techniques training should not be an added headache. One survey respondent suggested that in vitro techniques training be an option. Programs that can easily provide it should do so for multicompetency.

APPENDIX A

Comments regarding adequacy of student preparation in in vitro techniques:

1. We are fortunate to have an affiliate with a very large RIA lab, but it's the only hospital in the state to my knowledge that performs RIA within nuclear medicine. If or when this nuclear medicine department loses its RIA, our program will have difficulty in covering RIA in clinic.
2. One of our hospitals that currently does RIA in nuclear medicine will cease to do so this year. When the clinical lab takes over they will probably switch to other methods and we will no longer have ready access.
3. As for RIA, we could be doing more but I don't think we should do anything at all. If less than 10% of our profession is doing RIA, I think it could be removed from the JRC *Essentials*.

4. It is difficult because of the lack of in vitro testing in nuclear medicine departments in this city.
5. I feel that the theory of RIA is covered very well and as far as clinical practice, we are doing the best we can with the limitations we are under.
6. Students do not get enough practical experience. We have had no updated RIA equipment in 15 years. We were (2 years ago) sending them to an outside lab but they were only allowed to watch. In our area only MTs are allowed to do any RIA mostly due to economics.
7. Even before the RIA lab (in which our students received clinical training at our local VA) closed down our students were not adequately covering the in vitro aspect of the curriculum required by the *Essentials*.
8. Many of the clinical objectives cannot be met because there are no labs performing RIA.
9. Yes, because we have to. Is it necessary for their training? No!
10. Not RIA, not part of the *Essentials*. This survey does not understand in vitro definition.
11. This is becoming very difficult. I have just been notified that our lab has been taken over by another group. There are very few RIA procedures still done at our institution and these are spread over four different labs.
12. Yes, in regards to classroom learning. No, in regards to competency due to limited number of RIA exams done in my hospital.

APPENDIX B

Other survey comments:

1. I find having to lecture and provide clinical training in in vitro (RIA) techniques time consuming and difficult to achieve. It takes time away from lecturing and providing clinical training in what is nuclear medicine today, that being, in vivo imaging, in vivo nonimaging, in vivo therapeutic procedures and all the associated aspects of these procedures.

   I believe (RIA) in vitro techniques are historical to nuclear medicine and are not current to nuclear medicine. They can be taught to a small degree as lectures only. It should be noted that both the ARRT and NMTCB have removed (RIA) in vitro questions from the exams completely. Eliminating the time it takes to lecture and provide clinical experience in (RIA) in vitro techniques can provide more lecture and clinical time devoted to in vitro skills required in nonimaging in vivo procedures and radiopharmaceutical preparation.
2. Pathology departments are becoming less inclined to train NMT students in lab technique and in vitro studies. They receive no benefit from doing the training while investing time and money. I feel that RIA should be dropped from the NMT curriculum.
3. In the 13 years I've taught in nuclear medicine, no graduates have ever gotten a job doing RIA. It's done by medical techs., who rarely do it as well! Now that EIA/FPIA techniques are so prevalent, it makes so little sense for us to teach this.
4. I would like to see all in vitro requirements removed from the *Essentials*. This time could be better spent on in vivo studies in both clinical and didactic times.
5. We have had to find new affiliates to sponsor our RIA program, and the site visit and affiliate cost of yearly fees seems extraordinary considering our three students spend only 20 hours/year at the affiliate. With RIA being phased out in our immediate community, we now have to send our students 30 miles away to get training, and our facility pays their transportation expenses. The affiliate medical techs don't want to present lectures, so a CNMT presents the material and he's never done RIA. I feel our students receive just enough to get by, but our community resources are extremely limited. I don't know what will happen when the current affiliate phases out RIA!
6. I feel that the JRCNMT *Essentials and Guidelines* are not realistic due to the frequency of RIA procedures being performed in the area. In our program, we spend a lot of time learning lab techniques, that are applicable to blood volumes, Schilling, and WBC labeling, and lecture more on the historical aspects of RIA testing. It is frustrating even trying to obtain test kits since so many manufacturers are no longer producing them. Our hospital laboratory has discontinued RIA testing system wide (3 affiliate hospitals) in lieu of cheaper methods not relying on radioactive methods. Additionally, less than 20% of all techs ever practice RIA methods.
7. The pathology department at one of our affiliates has done the practical training for us in the past and they no longer want to have our students in their lab for 1 to 2 weeks. We're at their mercy.
8. With each year, it does become more difficult to meet the intent of the guidelines. It would be advisable that the JRCNMT determine the reasons the ARRT and NMTCB have dropped RIA testing.
9. We do a very good job of covering in vitro nuclear medicine including: blood volume determination, red cell survival, vitamin B_{12} Schilling test, thyroid uptake, etc. We have a difficult time with the *Essentials* for RIA–radioligands. As you can see, only three clinical laboratories are still performing radioisotope RIA–radioligand and neither the ARRT exam nor the NMTCB exam test this area. It is difficult to teach an area that the students will not need for employment nor certification or licensure. It is very outdated to continue to require programs to be held to Section II, Subsection B, Part 7 a, b, c of the JRCNMT *Essentials*.
10. Much of the JRC content should be extremely revised, as it does not reflect practice. The NMTCB realizes this.
11. I am utilizing our medical lab for clinical experience and staff for didactic instruction. Students have realized this experience will not be used in the area of employment and when counseling the student, most state this time

(clinical and didactic hours) could be more beneficial if used in other areas of the program. I agree with the students.

12. It's ridiculous to devote time, energy and money into an area that we are ill equipped to teach and to a subject that has become history. It is not practical. Please help us! Thanks for addressing our needs.
13. The clinical and didactic time spent on RIA needs to be used for practical nuclear medicine studies. I hope one of your goals is to send a copy of your results to the JRCNMT.
14. The JRC has stated that if resources are not available for practical RIA experience, they will make exceptions. I think we all should lobby to drop this requirement from the *Essentials*.
15. The JRCNMT should take a serious look at the federal law and determine how it applies to NMTs performing laboratory work as of January, 1997. See CFR Part 493.1489. NMTs that have not done in vitro tests prior to this date may not be able to do so without a medical lab degree.

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