

A Required Rotation in Clinical Laboratory Management for Pathology Residents: Five-Year Experience at Hofstra Northwell School of Medicine

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Abstract

Leadership and management training during pathology residency have been identified repeatedly by employers as insufficient. A 1-month rotation in clinical laboratory management (CLM) was created for third-year pathology residents. We report on our experience and assess the value of this rotation. The rotation was one-half observational and one-half active. The observational component involved being a member of department and laboratory service line leadership, both at the departmental and institutional level. Observational participation enabled learning of both the content and principles of leadership and management activities. The active half of the rotation was performance of a project intended to advance the strategic trajectory of the department and laboratory service line. In our program that matriculates 4 residents per year, 20 residents participated from April 2010 through December 2015. Their projects either activated a new priority area or helped propel an existing strategic priority forward. Of the 16 resident graduates who had obtained their first employment or a fellowship position, 9 responded to an assessment survey. The majority of respondents (5/9) felt that the rotation significantly contributed to their ability to compete for a fellowship or their first employment position. The top reported benefits of the rotation included people management; communication with staff, departmental, and institutional leadership; and involvement in department and institutional meetings and task groups. Our 5-year experience demonstrates both the successful principles by which the CLM rotation can be established and the high value of this rotation to residency graduates.

Keywords

laboratory administration, laboratory management, leadership, pathology residency

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Introduction

The discipline of pathology and laboratory medicine has evolved significantly from mostly being perceived by institutional stakeholders as a “subterranean” and mysterious science run by quiet basement dwellers, to the current status of active involvement in patient management, with critical opportunities for institutional leadership. Unfortunately, laboratory administration has repeatedly been identified as a domain of learning that needs strengthening in pathology residency training programs in the United States.^{1,2} Recently graduated pathology residents rank laboratory administration among the top areas where their learning during residency was insufficient for the needs of employment.^{3,4} In turn, employers prioritize

laboratory administration as a key domain of knowledge that they require of newly hired pathologists.^{5,6} In publications by the American Pathology Foundation, the American Society of Clinical Pathology (ASCP), the Pathology Residency Training

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Program Directors (PRODS) section of the Association of Pathology Chairs (APC), and Academy of Clinical Laboratory Physicians and Scientists (ACLPS), the objectives of a curriculum in laboratory administration are detailed.^{7,8} The challenge is for pathology residency training programs to incorporate those learning objectives into their categorical training experience. Graylyn conference recommendations of the conjoint ACLPS, ASCP, APC, and College of American Pathologists (CAP) taskforce state that residents should be capable of directing and managing clinical laboratory services and play an influential role in medical staff and health-care delivery activities that reach beyond the confines of the laboratory.⁹ These publications have emphasized gaps in the residency training pertaining to the “softer” skills such as communication, interpersonal skills, people management, professionalism, and higher-order skills required to step forward in laboratory directorship and leadership. Increased exposure of pathology residents to clinical laboratory management (CLM) has been an active point of discussion among PRODS, including feature sessions on this topic at the annual summer meeting of the APC (<http://www.apcprods.org/Newsletters/June2010/gme.html>). Finally, formal residency training in CLM has been called for through APC-PRODS working groups in laboratory management¹⁰ and pathology milestones working groups.¹¹

Recognizing this need, Web-based offerings have been created, such as the ASCP Laboratory Management University and the CAP Virtual Management College. Textbook material and review articles^{2,12-17} also help provide curriculum material for learning in laboratory administration. Throughout the country, department of pathology and laboratory medicine faculty teach through didactic lectures, “call review” sessions, and other classroom activities that might focus on laboratory administration.

However, the heart of learning is an active mentor-based experience.¹⁸⁻²⁰ Toward that end, in April 2010, our department created the “CLM” rotation in order to bring pathology residents into the active world of department leadership and management. We now report on our experience.

Clinical Laboratory Management: The Rotation

Objective

This 1-month rotation was established to provide our pathology residents with “hands-on” experience in laboratory management, while simultaneously creating a high level of awareness to the challenges confronted by the laboratory leadership on a daily basis. The rotation director is the department chair and the primary faculty; resident interaction is with the chair.

Timing

Borne out of a conversation between the department chair (J.M.C.) and a fourth-year pathology resident (S.H.), the CLM rotation was initially created as an elective for fourth-year

(postgraduate year [PGY]-4) residents. After the first cohort of PGY-4 residents went through the experience, the successor residents successfully advocated for CLM becoming a required rotation for the third year (PGY-3). The request for third year was based on their desire to gain CLM experience as soon as possible and then be part of the larger world of laboratory leadership and management for the remainder of their categorical residency training. A 1-month rotation was chosen rather than a longer part-time experience, both to synchronize the learning experience with the standing monthly rotation calendar of the training program and more importantly to ensure that the pathology resident was engaged in the management experience full time. In essence, for 1 month, each pathology resident would experience full time the daily work life of senior leadership.

Environment

Northwell Health is one of the nation’s largest nonprofit, secular health systems, with 19 hospitals representing more than 6400 hospital and long-term care beds, 3 skilled nursing facilities, over 450 ambulatory practice sites, and over 60 000 employees. The system serves a market area that includes the 5 boroughs of New York City, Westchester County, and Nassau and Suffolk Counties in Long Island. In 2014, there were 147 731 ambulatory surgeries, 276 495 hospital discharges, and over 4 million unique patient contacts. The Northwell Health Laboratories, and the department of pathology and laboratory medicine that oversees those laboratories, are integrated across the length and breadth of the health system. Over 90 pathologists and 7 clinical PhD scientists cover the clinical laboratories of the 5 tertiary, 9 community, 3 specialty, and 2 affiliated hospitals of the health system and the centralized reference laboratory. Both through health system growth and growth in the laboratory “outreach” program, the annualized growth rate of system-wide laboratory test volumes has exceeded 20% per year for the past 7 years. In addition, Northwell Health Laboratories is partner to 2 joint ventures. The first is with New York City Health & Hospitals (H+H) to form an integrated laboratory network across both health systems, creating a larger integrated laboratory network with the 11 acute and community hospitals and associated ambulatory clinics and services of H+H, the second largest publicly funded health system in the United States. The second is with OPKO/BioReference Laboratories to provide full-service genomic testing to the Northwell Health system, with its 16 000 unique patients with cancer treated per year and nearly 40 000 live births. The pathology resident on the CLM rotation is part of this leadership environment, because the rotation mentor—the department chair—is also executive director and senior vice president of laboratory services for the entire health system and is medical director of both joint ventures. In turn, the senior department and laboratory service line leadership team, of which the CLM resident is part, is overseeing a highly dynamic integrated laboratory network.

Rotation Design

The rotation is split into 2 roughly equal parts, which run in parallel: observation and a mentored active project (Table 1). The observation portion is dependent upon department and laboratory service line activities, and priorities, for the month. In the simplest sense, the resident is living the life of the department chair by experiencing the breadth of meetings required of a department leader. The department chair prepares the resident before every meeting, including relevant reading materials when available, prior committee or task force minutes and work products, relevant publications, and (as time allows) tutorial on what to expect. As soon as possible after every meeting, the chair and resident debrief, with the fundamental question being what did you think of the meeting? Resident responses to this question are insightful and, not uncommonly, valuable in shaping the department chair's thinking about the topic. The balance of meeting attendance between intradepartmental, institutional, and national (as through conference calls) is entirely dependent upon the month's schedule. One month's sampling is considered sufficient to impress upon the resident the breadth of engagement required of laboratory leadership. At both the department and institutional level, the selection of meetings to attend is guided in part by the resident's specific interests, so as to maximize alignment of the rotation's learning objectives with the resident's career interests. This includes setting a low threshold for resident involvement with meetings that the chair is not attending to ensure that the resident is seeing a broader horizon than just the department chair's line-of-sight. Finally, and to the extent that the chair is actively involved in national activities, the resident has opportunity to observe the dynamics of involvement with the national agenda of pathology and organized medicine. In the last instance, the observational experience is clearly dependent upon the interests of the chair.

The active project is the heart of this rotation. The pathology resident is empowered with the delegated authority of the chair to execute a project on behalf of the department. This includes authority to convene meetings, request appointments with institutional officials of almost any rank but the most senior, travel to other institutions in pursuit of relevant information, and the option of prioritizing project needs over observational activities (particularly during the third and fourth weeks) in order to bring the project to a state of completion. The project is heavily mentored to ensure both that the residents are productive and that they adhere to the highest standards of professionalism and integrity. The mentorship always includes the department chair but, in most instances, also includes a secondary faculty mentor who is a subject matter expert for the specific project. In almost all instances, the pathology resident is also working with a senior department administrator or team of administrators, appropriate to the project topic. The mentored project requires completion of an enduring product to be conveyed to department leadership and management for its continuation.

The rotation includes opportunity for the pathology resident to attend a national meeting that the chair might be attending,

Table 1. Clinical Laboratory Management: Rotation Structure.

Activity	Elements
Observation	Department and laboratory service line Medical director meetings Laboratory administrator meetings Finance and budget meetings Personnel management meetings (selected) Quality, safety, regulatory, compliance meetings Laboratory information services and informatics meetings Strategic planning meetings Marketing and client service meetings, including client visits Institution Hospital committee meetings Credentialing and medical staff meetings Finance and budget meetings Quality, safety, regulatory, compliance meetings Strategic planning meetings Medical group governance and committee meetings Hospital administration: laboratory meetings Corporate leadership: laboratory meetings Board of trustee meetings National Per the activities of the department chair To include travel to one national meeting that chair is attending
Active project	Relevant to department needs of that month Relevant to pathology resident's specific career interests Either a new project or continuation of an existing project Mentorship by department chair and/or subject matter expert Chronology Week 1: Familiarization with department issues, selection of project topic. Development of project objectives, tactical approach, time line, and proposed deliverables Week 2: Intense study of project topic: literature, institutional history, and institutional data. Interactions with relevant institutional personnel, including interviews and called meetings Week 3: Active institutional management of project, including called meetings, field investigation, and interviews Week 4: Creation of enduring product, to include (and/or) written report, oral presentation to appropriate management group, and table-top work session with appropriate management group. Formal handoff to appropriate manager for continuation and follow-through As scheduled: Presentation to pathology residents and faculty

provided that the meeting is relevant to the topic of laboratory administration. Since such national meetings are different than the usual national meetings of the academic pathology community, rotation scheduling attempts to align with the calendar of

Table 2. Clinical Laboratory Management: Rotation Deliverables.

Target Area	Elements
Benefit to the department	<p>Activation of a new priority area or continuation of an existing priority area</p> <p>Measurable progress toward a quantifiable goal</p> <p>An enduring product that management can continue with, including sufficient annotation for a new individual to assume responsibility for the project</p>
Benefit to the pathology resident	<p>Knowledge of the responsibilities and required institutional engagement of laboratory leadership</p> <p>Knowledge of the national policies and trends impacting on the laboratory industry</p> <p>Knowledge of the active workings of national organizations</p> <p>An enduring product from their project, worthy of inclusion on their resume</p> <p>Sufficient understanding of laboratory administration as to set them apart from other recent residency graduates</p> <p>Insight into what makes a good employer to work for</p>

appropriate meetings. Although the business travel is time away from both the observational and active portions of the local rotation experience, national exposure to issues of the laboratory industry is deemed highly valuable.

Rotation Deliverables

The targeted outcomes of the rotation fall into 2 areas: benefit to the department and benefit to the pathology resident (Table 2). In the first instance, the question posed to the resident on the first day of the 1-month rotation is: where does the department need to be by the end of this month and what are you going to do about it? Under the mentorship of the department chair, it is the resident's responsibility to get to the agreed upon end point of a chosen project. In the second instance, the goal is to provide the residents with intense training in leadership and management, so that they are changed individuals. Inwardly, that change is manifest as knowledge and experience. Outwardly, the successful performance of a project is evidence of leadership capabilities and hopefully an enhancement of their competitiveness as potential hires by a future employer. Parenthetically, an advantage of CLM rotations scheduled early in PGY-3 is that the chair's letter of recommendation for applications to fellowship training programs is directly informed by his work with that resident during the 1-month CLM rotation. Third, an openly declared collateral benefit of the CLM rotation is the hope that the pathology resident will have increased acumen about what employers they might want to work for.

Table 3. Clinical Laboratory Management: Rotation Competencies.

- **Medical knowledge:** Residents will demonstrate knowledge about established and evolving principles of laboratory management and medical director leadership and the application of this knowledge to patient care. This should include an understanding of the etiology (including molecular basis of disease), epidemiology, pathogenesis, clinical manifestations, laboratory diagnosis, and differential diagnosis and the application of this knowledge to pathology and laboratory medicine.
- **Patient care:** Residents will continue to develop skills required for overseeing successful delivery of patient care services through a clinical laboratory. This will include attention to patient-centered care and the place of pathology and laboratory medicine in the broader context of coordinated care.
- **Professionalism:** Residents will demonstrate a high standard of professional, ethical, and responsible behavior in their interactions with other members of the health system team. They will also demonstrate a knowledge and understanding of local and national regulatory requirement and their application to clinical and laboratory practice.
- **Practice-based learning and improvement:** Residents will continue to apply principles of practice-based learning and continuous process improvement. Demonstrate the ability to appropriately utilize information system technology. Residents should demonstrate the ability to identify their strengths and weaknesses and to implement strategies to improve their knowledge and skills and processes of patient care. Residents will participate in performance improvement activities, critical assessment of medical literature in support of practice patterns, and patient management.
- **Communication:** The resident will learn interpersonal and communication skills that results in effective information exchange and collaboration with patients and their families. Health professionals (attending, fellow, and laboratory staff) within the department of pathology and laboratory medicine. This should include effective written and verbal communication and effective teaching and presentation skills.
- **Systems-based practice:** The resident will demonstrate an awareness and understanding of the need to respond to the larger context of the health-care system and the ability to effectively call on system resources to provide pathology and laboratory medicine services. The resident will also demonstrate the ability to utilize evidence-based, cost conscious strategies to provide laboratory services and patient care that are of optimal value.

Clinical Laboratory Management: Competencies

Table 3 provides a crosswalk of CLM rotation objectives with the 6 competencies. Although all 6 competency areas are in play during the rotation, the rotation director (the department chair) has observed that there is a striking enhancement of professionalism. Specifically, at the start of the rotation, the resident is counseled on the behavioral and dress requirements for participation in leadership meetings within the department and laboratory service line and for attendance at any enterprise-level meeting. In turn, the resident observes the behavior and professionalism of others in attendance at scheduled meetings and the professionalism of department management and leadership at all times. For many, this is a transformational rotation,

Table 4. Clinical Laboratory Management: Rotation Projects.

Year-Month	Project Topic	Project Deliverable
2010-April	Creation of CLM rotation	The first resident CLM rotation
2010-November	Anatomic pathology quality program	Integration of 3 AP sites to 1
2010-December	Anatomic pathology quality program	Integration of 3 AP sites to 1
2011-September	Critical values notification	Creation of "hypercritical" program
2011-October	Split-donor platelets program	Implementation of SDP program
2011-November	6-Color flow cytometer protocols	Creation of SOP for 6-color flow
2012-January	Mobile applications	White paper on physician portal
2012-February	Point-of-care glucometers	Use of POC glucometers in ambulances
2012-June	wRVUs versus L4E	Comparison of US and Canadian systems for measuring work
2013-June	Hematopathology integrated reports	Industry analysis of report formats
2013-October	Creation of informatics rotation	The first resident informatics rotation
2014-January	Patient portal design	Industry analysis of patient portals
2014-February	Anatomic Pathology Research Survival Guide (2 residents)	Guide for Pathology Residents
2014-March	IRB Survival Guide	Guide for Pathology Residents and Faculty
2015-April	Autopsy competencies	The first SAM for pathology faculty
2015-June	Biobanking	White paper on enterprise biobanking
2015-July	Genomics informatics	White paper on structured data required for genomics
2015-October	Blood culture identification	Industry analysis of FilmArray
2015-November	Biobanking	Standard operating procedure for pancreas biobanking

Abbreviations: AP, anatomic pathology; CLM, clinical laboratory management; IRB, institutional review board; L4E, level-4 equivalents; POC, point of care; SAM, self-assessment module; SDP, split-donor platelets; SOP, standard operating procedure; wRVU, work relative value units

and most residents then adhere to a higher standard of appearance, demeanor, and self-presentation for the duration of their residency.

Outcomes

The Observational Component

Using the department chair's monthly calendar as a guide, the scheduled meetings are approximately 60% internal to the department and laboratory service line, 35% institutional, inclusive of hospital and enterprise meetings, and 5% national conference calls. The pathology residents are immediately welcomed into the internal meetings, and their absence is felt during the 8 months of the year that a resident is not on the CLM rotation. Residents are able to attend meetings involving generic discussions of personnel management and human resources but are excluded when specific issues of privacy and employee rights are in play. At the institutional level, the department uniformly receives compliments from institutional leadership for including "learners" in the affairs of the enterprise. Only rarely is there an institutional meeting for which the resident must be excluded, typically confidential matters of enterprise strategy, finance, and business decision-making.

The inclusion of pathology residents in high-level enterprise meetings requires a high level of trust to be in play. At the outset of the rotation, the department chair counsels the pathology resident on the integrity, and discretion, required to be included in confidential meetings. The resident is then held to this standard. Second, at least once during any given rotation, a senior institutional leader seeks the perspective of the pathology resident in attendance. The resident is forewarned

always to be ready to respond to such questions, especially since in such instances, the pathology resident may be speaking for all graduate medical education trainees in the health system. Finally, other clinical departments have occasionally emulated the example of the department of pathology, most often by invitation of their respective chief residents to selected institutional meetings.

Rotation Deliverables

Our pathology residency training program enrolls 4 trainees per year. To date, 20 residents have been on the CLM rotation. Their projects are listed in Table 4. The very first rotation was the brainchild of the very first resident (S.H.); creation of the CLM rotation was the project deliverable. The linked 2-month project of the second and third rotations was at the instigation of those 2 residents, who saw that the impending integration of 3 anatomic pathology practice sites into 1 location did not have an adequate quality management program.²¹ These 2 residents worked with department quality leadership to ensure that we did, indeed, have the necessary programming; the residents' performance on the project was influential in our department hiring one of them back onto faculty upon completion of his fellowship training. Each subsequent project has had lasting impact on the department, including major enhancements in patient care (eg, "hypercritical values notification protocols" protocols; implementation of split-donor platelets; protocols for compliant use of blood glucometers in ambulances; establishing protocols for implementation of 6-color flow cytometry), workforce management (eg, comparison of the American and Canadian systems for measuring work effort in

Table 5. Clinical Laboratory Management: Business Travel.

Association of Pathology Chairs
The Compass Group (www.thecompass-group.org)
Executive War College
G2 Laboratory Institute
Business visits to major national reference laboratories
Business visits to laboratory industry vendors

anatomic pathology), education (eg, creation of an informatics rotation, creation of survival guides for research in anatomic pathology), and business development (eg, mobile applications for both physician and patient portals). The residents' efforts were not in isolation. Their efforts were woven into the thriving fabric of departmental and laboratory service line ambition and need.

Business Travel

The national meetings and business visits attended by residents on the CLM rotation, during their rotation month, are given in Table 5. At the national meetings, the resident is given freedom in their choice of sessions to attend. They are required to give a report back to senior department and laboratory service line leadership at the immediate following Monday's "Executive Group meeting" on the take-away messages from the meeting they attended—just as this is required of other members of the executive group who attended the same meeting. On vendor-based business travel, the resident travels in firm alignment with the department delegation. As may be noted, these meetings and business travel are unusual destinations for pathology residents. In essentially every instance, the department is commended for bringing a pathology resident to such a meeting, the pathology resident's contributions to the meeting are well received, and the pathology resident serves as an outstanding ambassador for the department.

Residency In-Service Examination Scores

Although the activities of this CLM rotation were crosswalked to the 6 clinical competencies (see Table 3), there was no guarantee that measurable improvement would occur for test scores in laboratory administration. Table 6 shows the trends for "overall" laboratory administration test scores on the ASCP-administered Residency In-Service Examination (RISE), typically administered in March of the year. In the 4 years prior to the creation of this rotation (2007-2010), overall scores were in the 55 to 75 range, where 50 is the national median. The 2 years immediately after the creation of the rotation (2011 and 2012) saw overall test scores for our pathology residency (PGY-1 through PGY-4) of 80 and 80, respectively. In 2013, the overall score fell back to 65, and under the new scoring system of 2014 and 2015, our pathology residency was at or near the national median. Focusing on PGY-3 and PGY-4 residents, against their year-

Table 6. RISE Scores in Laboratory Administration*.

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
Overall	60	65	55	75	80	80	65	65	40
PGY-1	70	70	70	80	65	65	75	35	20
PGY-2	40	70	70	80	95	70	80	75	45
PGY-3	90	60	65	85	65	60	30	80	50
PGY-4	25	80	45	80	75	80	65	50	75

Abbreviations: PGY, postgraduate year; RISE, Residency In-Service Examination.

*RISE is administered by the American Society of Clinical Pathology. The 4 years of training are for a combined program in anatomic pathology and clinical pathology. In our program of 16 pathology residents, on average, 4 residents per PGY took the exam in any given year.

appropriate national peers, it would be difficult to argue that the institution of our CLM rotation led to clear improvement in laboratory administration test scores on a standardized examination.

Survey of Pathology Residency Training Program Graduates

An online anonymous survey was forwarded to the 16 residents who had completed the CLM rotation and graduated from the residency program. The survey consisted of 26 questions, of which 19 were multiple choice and 7 were free-text answers. The survey response rate was 56% (n = 9). The rating scale is given in Table 7. The semiquantitative survey results are given in Tables 8 and 9.

The majority of the respondents suggested a need for an 8-week rotation, with an option to include another 4 weeks of elective CLM rotation. Interestingly, the need for maximum extension of the CLM rotation was largely felt by the recently employed graduates (n = 5). In contrast, the respondents currently in fellowship positions (n = 2) suggested 4 weeks as the optimal duration of the rotation. All of the respondents reported mild to moderate awareness of the challenges faced by the laboratory leadership prior to the CLM exposure. This awareness level was perceived to be raised to high or very high after CLM rotation by 89% of the respondents.

In the observational portion of the rotation, meeting attendance, prebriefings, and postbriefings with the rotation director were perceived of better value than pre readings. For the intra-departmental observational component, the topics of strategy and finance were perceived of greater significance than personnel and quality. A similar trend of greater significance was seen toward the topics of finance and strategy for institutional-level meetings. For the active portion of the rotation, project selection, the requisite literature search, active project management, and creation of a durable product were all ranked high (average score of higher or close to 4). However, creation of a durable product out of the rotation project was perceived as the most important component.

Table 7. Levels of Awareness in Laboratory Management.

1 Low awareness	Understood the value of laboratory quality control.
2 Mild awareness	In addition to above, were aware of at least 4 laboratory regulatory agencies and participated in internal quality control maintenance.
3 Moderate awareness	In addition to above, were aware of roles that laboratory leadership played within a hospital-based administrative environment, including relations with hospital administration and medical staff and nursing leaders, and responsibilities of laboratory leadership to same.
4 High awareness	In addition to above, had good awareness of the leadership responsibilities of laboratory directors at the enterprise level, including corporate leadership; financial, legal, and managed care leadership; and the importance of involvement in enterprise governance.
5 Very high awareness	In addition to above, had contributed in a significant fashion to development of laboratory strategies, with involvement in laboratory management process decision-making and/or with experience in project development, management, and execution.

Six of 9 respondents mentioned that the CLM rotation was significant in their competing for a fellowship position, and most felt that the rotation helped them positively to perform as a fellow. Five of the 9 respondents mentioned that the CLM rotation significantly and positively affected their ability to compete for their first employment position.

For an effective CLM rotation, the experience of the rotation director and open communication with the rotation director were considered more important when compared to the basic rotation design. For the enterprise-level meetings, observation of the leadership present at the meetings and the meeting briefing/debriefings were valued more than the informational content of the meeting. Six of the 9 participants valued introduction of the trainee at the start of meeting. All of the participants considered positive reinforcement by the mentor for their active project participation as significant (average score 4.5).

When asked about negatives, long-term vacation (2 weeks, which occurred only once) by the resident during the rotation was considered as one of the most significant negative factors, followed by the department chair being out of town for off-site meetings. In the first instance, the rotation director also considers that the one resident's absence for 2 weeks led to this being the only "failed" rotation experience, as measured by the ability of the resident to complete an active project successfully. In the second instance, the rotation director now coordinates resident scheduling with his calendar so as to avoid months of excessive travel by the director. Mandatory

attendance at the routine pathology residency training sessions over simultaneously occurring CLM meetings was also perceived as an important negative parameter. Interestingly, most of the participants did not mind using electronic forms of communication to stay directly in touch with the rotation director.

When asked for suggesting a change for positive outcome, most of the participants agreed that having an opportunity to present their project to a larger audience and having an opportunity to implement and follow up the outcome of their project would further help reinforce their learning process. Six participants suggested opportunity to understand and implement the grant writing process would be an important positive inclusion for the rotation curriculum.

The participants felt that the CLM rotation prepared them well for the administrative/leadership role, delegation of authority, and educational and regulatory responsibilities of a medical director. Participants felt that the CLM rotation helped in overall development of the other skills beyond the confines of the laboratory such as entrepreneurial thinking, being mentor to future trainees, and acquiring leadership roles in professional organizations. The rotation strongly (average scale of 4 and above) helped in people management and communication with the staff, communication with the leadership within the department as well as at the institutional level, involvement in departmental and institutional meetings or task groups, communication with clients to troubleshoot and listen to their problems, project management, and understanding the competitiveness of the current laboratory medicine market/practice. The rotation moderately helped on developing strategies for their enterprise (average scale 3.6 of 5).

Free-text "open-ended" questions were asked to help understand the higher value of the rotation. The full responses are given in Supplemental Table 1. A brief summary of their responses includes:

- Pathology residents were more able to think "out of the box" for creative projects that they might perform moving forward.
- The CLM rotation better equipped some pathology residents to speak knowledgeably about management issues (such as Lean) during employment interviews and to take on administrative responsibilities immediately upon employment.
- The CLM rotation was of variable value to different residents in their preparation for RISE examinations or American Board of Pathology certification examinations.
- Major learning points included better understanding of (1) the importance of communication: beyond the pathology department, with management and staff; (2) the complexities of leading a change management project; (3) the importance of mentorship; and (4) the importance of leadership skills.

In their current employment, 7 of the 9 respondents were actively involved in quality assurance and quality control.

Table 8. Directed Questions*.

Question Asked	Response	Respondents
1 Was 4 weeks duration optimal for CLM rotation?	Disagree	5
	Agree	4
2 If you disagree then what should be the optimal duration?	Greater than 8 weeks	3
	8 weeks	2
3 How strongly do you think the CLM rotation affected your ability to compete for a fellowship position?	Was pivotal	2
	Very much so	4
	To some extent	2
	Not much	1
4 [†] How strongly did CLM rotation affect your ability to perform as a fellow?	Very much so	4
	To some extent	5
5 How strongly did CLM rotation affect your ability to compete for your first employment position?	Very significantly	3
	Very much so	2
	To some extent	2
	Not much	2
6 [‡] How strongly were you aware in your PGY-2 year of the challenges faced by laboratory leadership?	Moderate awareness	4
	Mild awareness	5
7 Following the 1-month CLM rotation, what was your awareness using the same scale as above in question 6?	Very high awareness	5
	High awareness	3
	Moderate awareness	1

Abbreviations: CLM, clinical laboratory management; PGY, postgraduate year.

*Total number of responses = 9.

[†]Other choices provided were not much and very significantly. Choices with zero responses are not shown.

[‡]See Table 6 for awareness grading.

Important other management projects in their current employment included (1) utilization management, (2) accreditation, (3) delegation of responsibilities, (4) root cause analysis, and (5) workforce communication.

Discussion

Our intent in creating the CLM rotation was to take action in addressing long-documented deficiencies in pathology residency training in laboratory management. The CLM rotation provided to our residents the opportunity to take an active role in practical leadership and management of pathology and laboratory medicine. The fundamental inspiration of including an active, mentored project was affirmed through the 5 years of residents' experience. It is important to note that "active" included the rotation director as well as the pathology resident—the mentoring process was active for the mentor as well! Joined with the "observational" component of the rotation, the pathology resident obtained wide exposure to the overall responsibilities of laboratory service line administration and leadership, with opportunity to gain a strong hold of, and an appreciation for, the strategic, regulatory, personnel, and financial requirements of such leadership.

The introduction of CLM to our residency training is perceived as a win-win for our program. On one hand, the rotation appears to be successful in giving pathology residents authentic experience in senior leadership and management, in a fashion that enhances their perception of their own competitiveness in the job market and their ability to take on management responsibilities at the time of initial employment. On the other hand,

the department benefits directly from the active project work of the pathology residents, in most instances with a lasting positive effect on department strategic trajectory. The projects highlighted in Table 4 represent alignment of resident interest with department need, and so at the outset had opportunity to be successfully executed. The abundant talent, and considerable work effort of the resident, could then become manifest in the delivery of high-quality products of value to the department. Along the way, the direct, matter-of-fact, and surprisingly non-intimidating communication with the department chair/rotation director was empowering and encouraged the pathology residents to bring their own creativity to bear on improving the department and overall laboratory service line. The survey finding that resident vacation or rotation director absences had a negative impact on the learning experience is in support of the premise that the "active" interaction between resident and chair is critically important to this rotation.

Opinions on the length of time for the rotation ran strong in our survey responses. The majority of our survey participants suggested that an 8-week CLM rotation would be of even greater value than the 4-week experience; the participants with recent employment also suggested opportunity for a further 4-week elective in CLM. We infer that the residents with recent employment are faced with true administrative challenges as compared to the fellows in training and therefore felt a need for an additional 4-week elective. The CLM rotation is currently (as of year 2016) in the form of a 1-month core curriculum (reported herein) and 1 month of elective rotation. We are unlikely to extend this experience at the current time, owing to competing Accreditation Council for Graduate Medical

Table 9. Score-Based Questions on Scale of 1 to 5, With 5 Being Most Significant.

	Average Score
1 Rank the following elements of observational component (meetings) of the rotation for importance to your learning process	
A Prereadings	2.8
B Prebriefings with rotation director	4.4
C Attendance	4.7
D Postbriefings with rotation director	4.5
2 Rank the following elements with regard to the project component (actual performance of the project) for importance to your learning process	
A Topic selection	4.1
B Literature search	3.7
C "Active" project management and execution	4.5
D Creation of the durable product	4.5
3 For the observational "intradepartmental" portion of the CLM rotation, rank each of the following topic areas significant to your learning process	
A Finance	4.3
B Strategy	4.6
C Personnel	4.2
D Quality	4.4
4 For the observational "institutional" portion of the CLM rotation, rank each of the following topic areas significant to your learning process	
A Medical group	3.6
B Finance and managed care	4.2
C Strategy	4.6
5 For the observational "national" portion of the CLM rotation, rank each of the following topic areas significant to your learning process	
A Conference calls	4.4
B Travel to the national meetings in the "CLM" space	4.1
6 Rank the following for an effective CLM rotation	
A Well-designed rotation curriculum	3.5
B Experience of the laboratory director	4.4
C Open nonhierarchical communication with the laboratory director	4.7
D Observational component of rotation	4.2
E Mandatory requirement of a project	4.0
7 Given an opportunity to attend enterprise-level meetings during the CLM rotation, grade the significance of each of the following activity	
A Informational content of the meeting	3.7
B Briefing/debriefing on the relevance of content	4.5
C Observation of the enterprise leadership present at that meeting	4.5
D Introduction of the trainee at the start of meeting	4.3
E Welcome into active participation in the meeting	4.6
8 Which of the following may be considered as to potentially have negative effect on CLM rotation experience?	
A Long-term resident vacation (2 weeks) during the rotation	4.3
B Excessive meetings	2.8
C Inadequate briefing/debriefing with the chair	4.3
D Departmental chair out of office for numerous off-site meetings	3.4
E CLM rotation scheduled too early during the residency	3.4
F Nondirect interaction with department chair (through e-mails and conference calls)	3.2
G Mandatory attendance at routine AP-CP training sessions being prioritized over simultaneously occurring CLM meetings	3.7
9 Given a chance to do a CLM rotation again, what would you like to change?	
A Curriculum	3.0
B Duration of rotation	2.4
C Opportunity to present your project to larger audience	3.1
D Opportunity to follow up the implementation/outcome of your project	3.3
E Opportunity to understand and implement grant writing	3.5

(continued)

Table 9. (continued)

	Average Score
10 How strongly did CLM rotation prepare you for each of the following medical director's role?	
A Administrative/leadership responsibilities	4.2
B Educational responsibilities	3.6
C Delegation	3.7
D Regulations and liabilities of medical director	4.2
11 How strongly did CLM rotation prepare you for each of the following?	
A Medical informatics	3.1
B Entrepreneurial thinking	4.1
C Being a mentor to your future trainees	4.0
D Acquiring leadership role at professional organization (regional or national)	4.2
12 Rank whether the CLM rotation experience is helping you perform the following aspects at your current position?	
A People management and communication with the staff	4.2
B Communication with department and institutional leadership	4.1
C Involvement in department and institutional meetings and/or task groups	4.2
D Communication with the clients and understanding their problems	3.8
E Understanding the competitive market environment	3.8
F Development of strategies for your enterprise	3.5
G Project management	3.8

Abbreviations: AP, anatomic pathology; CP, clinical pathology; CLM, clinical laboratory management.

Education requirements in other parts of categorical training in anatomic pathology and clinical pathology.

All this being said, it is the full-time nature of the rotation that drives home the point that leadership positions are fast paced, invigorating, kaleidoscopic, and highly fulfilling. A common observation is, "I had no idea that there was so much going on!" Hence, we strongly hold to the premise that the full-time nature of even this 1-month rotation provides value that cannot be achieved through part-time touch points occurring over the course of a 3- to 4-year pathology residency. Specifically, the observational component of the rotation provided residents with opportunity to broadly experience the challenges faced and managed by the laboratory directors as well as the senior management at the institutional and enterprise level. The lasting value of this experience for the trainees includes enhanced skills in conflict resolution, professionalism, strategic planning, time management, and people management. The active component of the rotation ensures that residents realize that leadership actually has to "do something." Skills learned include project management, communication, and interdisciplinary and interprofessional collaboration.

An interesting finding of the survey was the feedback that prereadings for the observational meetings were not significantly helpful (average score 2.8). This correlates with the rating of informational content of meetings as only moderately beneficial (average score 3.7). Instead, it was observation of enterprise leadership that was deemed more important (average score 4.5). Besides being assurance that the actual content of the month's agenda is less critical, the survey underscores the

premise that it is exposure to the principles (and "soft skills") of leadership and management that is more important for the observational component of the rotation.

The inclusion of our pathology residents in both laboratory service line and enterprise high-level meetings involving sensitive and confidential issues reflects a strong institutional culture of empowering learners in leadership. A Northwell Health Administrative Fellowship program has been in existence for 11 years. Through a highly competitive application process, 3 to 5 administrative fellows per year enroll in an intense 1-year program at the level of the chief executive suite (the "C-suite"). For the first 9 years of the program, fellows were drawn from the ranks of MBA, MPH, or MHA degree holders; in the last 2 years, physicians (MD) are now included. At the current time, 50 graduates of this fellowship program have been retained as health system employees (almost all of them), some at very high levels of the organization. Our CLM rotation aligns well with the previously established principles for success of the administrative fellowship program: outstanding individuals are enrolled; there is a strong record of accomplishment of the administrative fellows; their work effort is aligned with the strategies of the organization; and there is a strong record of trust (Kathleen Gallo, PhD, MBA, RN; senior vice president and chief learning officer for Northwell Health; founding dean, Hofstra Northwell School of Graduate Nursing and Physicians Assistants; personal communication). Particularly in the last instance, our pathology residents have not violated the trust placed in them. Conversely, it is precisely the placement of trust in them that engenders a learning experience of very high value.

Most of the survey participants stated that the CLM rotation helped in their competing for the fellowship and employment. The responses indicate that the residents were able to speak up better on management-related issues, had improved communication skills, and had better confidence backed by true examples and acquired project management skills. In addition, working closely and actively with the department senior leadership created the opportunity for more objective and well-informed letters of recommendation for the fellowship positions. However, the fellowship advantage was not limited to only this aspect. The CLM trainees perceived that the ability to refine their career interests during the rotation assisted them in seeking fellowship positions at the most competitive programs.

Importantly, the survey indicated that although the CLM rotation helped in preparing for board exams, the practical knowledge acquired could not be equated with textbook study. We agree with this feedback, as the objective evaluation by the RISE scores did not show significant numerical differences pre- and post-institution of the CLM rotation in our program. We would rather suggest that the RISE scores are not the accurate indicator of the skill sets developed during the CLM rotation. Even the conventional approach to teaching laboratory management has not significantly affected RISE scores.²² Taken collectively, we conclude that we should not be aiming our CLM rotation to improve the RISE or board examination scores; we are teaching skills that do not appear to be assessed by these standardized examinations. Instead, we hope that this report, including our survey evaluation tool (Table 7) in combination with leadership and management-specific milestone competencies,²³ may assist in future assessment of skill development in this particular area of “CLM.”

During the rotation, we did not assign time for online learning modules, extensive prereadings, or pre- and postrotation test assessment. We, therefore, cannot comment on the potential contribution of these independent tools for laboratory administration learning, noting instead that these tools are available throughout all 48 months of our anatomical pathology and clinical pathology residency training program. Rather, time on this CLM rotation was prioritized in favor of execution of the active project. We consider the execution of a successful project (Table 4) to be objective evidence of a successful learning experience.

In conclusion, we present evidence that our CLM rotation, under active mentorship by a senior department leader, was an effective mechanism for advancing pathology resident education in laboratory administration. The higher skills of leadership, professionalism, project management, and communication across the breadth of a health system were particular focus points of this rotation. This rotation is unconventional in that a pathology resident is an integral member of the most senior leadership team of the department and laboratory service line for the duration of the month rotation, including having the delegated authority of the department chair for execution of a strategic project. We consider that this exposure to—and participation in—the otherwise unseen activities of department

leadership and management will help close the gap between conventional pathology residency training and what is needed for successful performance in laboratory administration. To quote one pathology resident upon completion of the CLM rotation, “I finally got to be part of the big room.”

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Supplemental Table 1. Open ended questions (9 respondents).

- I. What “out of the box” projects or ideas came to your mind following your CLM rotation?
 - Develop and strengthen the laboratory’s relationship with other departments to optimize specimen collection, prevent misunderstandings, combine efforts for utilization, and provide better patient care. This can be fostered early on in medical school and in residency if there is more interaction between pathology residents and clinical residents (patient rounds in the lab, presenting at one another’s grand rounds, and setting up committees to deal with specific issues)
 - Following CLM rotation, I got to know people in administration. I did participate in mini-LEAN projects beyond CLM rotation, out of interest. I also attended some AP lab meeting and did one week elective (mixed with Frozen section) at immunohistochemistry lab
 - Streamlining of processes in the technical component of our practice
 - To create retrievable databases for disease entities and link them with clinical outcomes as well as the current literature. There could be many algorithms that may be made using the informatics, which could be applied to population wide screening, prevention of disease, education and research. This may be also used to link with and add to the human protein atlas. The opportunities could be unlimited.
 - Use of telepathology for teaching
 - Implementation of informatics rotation
 - The CLM rotation was the most important factor in cementing my decision to pursue a different career track (i.e. not a regular pathology fellowship position). I had some idea about health care reform going into the rotation. But after I completed my rotation, I was exposed to health care delivery models like ACOs, PCMH and rapidly evolving enterprise health care strategies. The CLM rotation was my window into the broader world of healthcare policy and management and I may not have pursued a MPH degree if did not have this experience during residency.
 - Not applicable
 - None

(continued)

2. Were you able to initiate or pursue your “out of box” idea(s) following the CLM rotation either during or after your residency? If not then please provide brief comment on the limiting factor
 - Yes (3)
 - No (4)
 - Not applicable (2)
3. If the CLM rotation was helpful in acquiring employment then please provide a brief comment on how the rotation was helpful?
 - Yes, gave me a clear advantage when I could speak to management-related issues on interviews.
 - I accepted a position as a Pathology Informatics as my first full time job after residency training. My experiences during CLM rotation and the relationships I had built with people were key in that decision making process. Clinical Informatics is still a nascent field but the CLM rotation had convinced me that this was a viable and very interesting career option.
 - Several employers have noticed my interest in LEAN and have asked about that. Also have been asked about possible leadership roles in IHC lab.
 - The observational component of rotation helped me in appreciating and to some extent acquiring the demeanor of my mentors. The rotation made me a better communicator on the aspects of laboratory issues and sharpened my critical thinking, questioning ability as well as problem solving for the multifactor lab directorship issues. It made me aware of the limitations as well as the possibilities of the world beyond laboratory.
 - Right out of fellowship I interviewed for a spot that required administrative responsibilities; I felt that the work I did during the CLM rotation set a solid foundation to know what to expect and how to handle the challenges I was about to face.
 - Yes. The rotation allowed me to have a “deliverable” that I was able to incorporate into my CV and speak about during interviews.
 - Not helpful
 - Not applicable (2)
4. How significantly or insignificantly did CLM rotation prepare you for the management portion of AP-CP board and RISE examinations? Please provide with brief comment.
 - Very significantly helpful for CP boards: Many questions pertain to lab management, and were not things I specifically studied for but rather picked up through observation on the rotation.
 - Significantly, especially questions about quality management, leadership theory and laboratory statistics.
 - Not really because rotation is more practical than theoretical at least during my time.
 - Laboratory management training was helpful
 - The hands-on experience did help me in understanding the laboratory management questions in boards exam. However, the knowledge acquired during the CLM rotation is unlikely to be reproduced by reading a book.
 - Prepared me very well. I scored above 90% on the RISE and passed the boards.
 - No it didn't. CLM rotation is more for experience. AP-CP and RISE are more textbook oriented questions, not real life situations.
 - Felt much more prepared for boards in management portion, information learned was also in the questions asked.
 - Not much helpful
5. What major learning points that you acquired during the CLM rotation were helpful or transformational for you as a young pathologist to be in practice? Please provide up to three
 - Understanding the broader role of the pathologist and the potential impact a pathologist can have on patients, a health system as a whole, and public health.
 - Power of dialogue and negotiations
 - Impact of pathologist beyond pathology department. 2. Examples of how to be involved at inter-institutional and national level 3. importance of developing an area of interest for future practice
 - Communication with the staff 2. Seeking for leadership roles (not successful yet) 3. Active mentoring of the residents
 - There are multiple layers to even the simplest change that need to be thought of and assessed. 2. Just because something is a good idea and may benefit the department/service line does not mean you can just implement it because those at corporate headquarters may not want to (for other reasons that have nothing to do with patient care).
 - People management 2) Communication with others 3) Participation in side groups and projects
 - Learning about health care reform and evolving health care delivery models (ACOs, PCMH) 2) Leadership skills and organizational behavior (e.g. how should a Pathologist get involved in enterprise level initiatives, management of a large service line) 3) Articulating and executing strategy
 - No response to question (2)
6. Are you actively involved in quality assurance and quality control at your current position? Please specify your role.
 - Yes (7)
 - No (2)
7. What is the most significant management related challenge you have/had faced during your current position. (Please specify one). If relevant, how did your CLM experience help you deal with this challenge?
 - Developing utilization strategies for my department. I learned how to organize such an effort, how to get “buy in” from clinicians, and implement a change in standard operating procedures.
 - Our current biggest goal is to get accreditation. Challenges included: write SOP's from scratch, making a whole organizational re-structuring (creating and deleting positions), and developing outreach programs (internship, medical school rotations, etc). What I experienced during the CLM rotation helped me have a clear vision of how to execute the plans.
 - Delegating responsibilities during extremely busy days.
 - Communication with the laboratory staff on the quality issues. CLM rotation helped me understand the much needed appreciation as well as encouragement for the laboratory staff. I managed quality issues by addressing to the root cause with the CLM thought process that every lab process disorder must have a reason (personnel vs. technical) and not creating a “complaining” message.
 - Too early in current position
 - Not applicable (2)
 - No response to question (2)

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