

## ROLE OF SURGICAL RESIDENTS IN UNDERGRADUATE SURGICAL EDUCATION

Marc Pelletier, MD; Paul Belliveau, MD

**OBJECTIVES:** To identify the role and impact of surgical residents on the various activities of a senior (4th year) surgical clerkship, and to explore students' perceptions of differences between the teaching behaviours of attending physicians and residents.

**DESIGN:** A survey by questionnaire.

**SETTING:** McGill University, Montreal.

**METHOD:** A 67-item questionnaire was administered to fourth-year medical students at the end of their 8-week surgical clerkship. Analysis of the data was performed using the Wilcoxon signed-rank test, Dunn's multiple comparison test and mean average.

**MAIN OUTCOME MEASURES:** Overall satisfaction with the clerkship, teaching behaviours and teaching of clinical skills and basic principles.

**RESULTS:** Overall satisfaction with the clerkship was 6.31 out of 10. Surgical residents were perceived as being significantly more active than the attending staff in 14 out of 15 teaching behaviours. They were also seen as important in teaching certain clinical skills such as suturing, assisting in the operating room and managing emergency situations. They also contributed significantly to teaching the basic principles of surgery such as infections, surgical bleeding and fluid and electrolytes. On a 10-point scale, students felt that more learning was achieved by independent reading, tutorials and residents' teaching than by other teaching modalities, including attending physicians' and nurses' teaching.

**CONCLUSIONS:** Medical students perceive surgical residents as being significantly more active in their education process than the attending staff. Residents appear to be responsible for teaching various technical and patient management skills necessary for patient care. Along with independent reading and tutorials, resident teaching contributes a significant portion of the medical student's acquisition of knowledge and appears to contribute to the students' choice of surgery as a career.

---

**OBJECTIFS :** Définir le rôle des résidents en chirurgie et leur impact sur les diverses activités d'un stage clinique en chirurgie de dernière année (4<sup>e</sup> année) et explorer ce que les étudiants pensent des différences entre les comportements pédagogiques des médecins traitants et des résidents.

**CONCEPT :** Enquête par questionnaire.

**CONTEXTE :** Université McGill, Montréal.

**MÉTHODE :** On a administré un questionnaire de 67 questions à des étudiants en médecine de 4<sup>e</sup> année à la fin de leur stage clinique de 8 semaines en chirurgie. On a analysé les données au moyen du test de Wilcoxon pour observations appariées, du test de comparaison multiple de Dunn et de la moyenne arithmétique.

**PRINCIPALES MESURES DE RÉSULTATS :** Satisfaction globale à l'égard du stage clinique, des comportements pédagogiques et de l'enseignement des compétences cliniques et des principes fondamentaux.

**RÉSULTATS :** La satisfaction globale à l'égard du stage clinique s'est établie à 6,31 sur 10. On estimait que les résidents en chirurgie étaient beaucoup plus actifs que le personnel traitant dans 14 des 15 comporte-

*From the Division of General Surgery, Department of Surgery, McGill University, Montreal, Que.*

*Presented as a poster at the annual meeting of the Association for Surgical Education, Lexington, Ky, Apr. 10 to 13, 1996.*

*Accepted for publication Nov. 3, 1998.*

**Correspondence to:** Dr. Marc Pelletier, Rm. C9.169, The Montreal General Hospital, 1650 Cedar Ave., Montreal QC H3G 1A4; fax 514 934-8289, mres22@med.mcgill.ca

© 1999 Canadian Medical Association (text and abstract/résumé)

ments d'enseignement. On les a jugés importants aussi dans l'enseignement de certaines techniques cliniques comme la pose de sutures, l'aide à la salle d'opération et la prise en charge des situations d'urgence. Ils ont aussi contribué considérablement à l'enseignement des principes de base de la chirurgie comme les infections, le saignement chirurgical, les liquides et les électrolytes. Sur une échelle de 10 points, les étudiants ont jugé qu'ils apprenaient davantage par la lecture indépendante, les tutoriels et l'enseignement donné par les résidents que par d'autres moyens, y compris l'enseignement donné par les médecins traitants et les infirmières.

**CONCLUSIONS :** Les étudiants en médecine considèrent que les résidents en chirurgie jouent, dans leur formation, un rôle beaucoup plus actif que le personnel traitant. Les résidents semblent chargés d'enseigner diverses techniques et compétences en gestion des patients nécessaires pour traiter les patients. Outre les lectures indépendantes et les tutoriels, l'enseignement donné par les résidents contribue à une partie importante de l'acquisition de savoir d'un étudiant en médecine et semble aider les étudiants à choisir la chirurgie comme carrière.

Recent trends in medical education have emphasized a shift toward self-directed learning and a renewed focus on basic clinical skills.<sup>1</sup> For surgical program directors, implementing these ideas and assuring their effectiveness often causes logistical problems. In some fields of medicine, such as pediatrics and internal medicine, residents are recognized as important, influential teachers of medical students.<sup>2-4</sup> Efforts to optimize the resident's role in education have yielded encouraging results with teaching retreats<sup>5</sup> and teaching rotations for residents.<sup>6</sup> However, few studies have looked specifically at general surgery residents<sup>7</sup> and their role in the educational stream.<sup>8</sup> Data are also scarce on quantifying the amount of teaching that students derive from residents as opposed to attending staff and various other activities (seminars, lectures and rounds).

In general surgery, students are assigned to a surgical team where a great proportion of their time is spent interacting with the residents, who have not traditionally been trained as teachers. The purpose of this study was to identify the role and impact of surgical residents in the various activities of a senior (4th year) surgical clerkship. We also attempted to explore students' perception of differences between attending physicians and residents in their teaching behaviours during clinical clerkships.

## METHODS

A 67-item questionnaire, based on previous studies in this field,<sup>9</sup> was created to optimize quantifiable data such as Likert-type scales (Fig. 1). It was administered to all groups of senior medical students at the end of their 8-week surgical clerkship at McGill University during the 1994/95 academic year. It was divided into 7 groups of questions inquiring about various activities and interactions students had experienced. Students were informed that responses were independent of their rotation evaluations and would not be seen by surgical staff or residents.

In the first 2 groups of questions, students were asked to compare the frequency with which attending physicians and residents evidenced certain teaching behaviours such as teaching, role modelling and providing feedback. A total of 30 variables were available, 15 each for attending physicians and residents. For each question, a 3-point coding system was used, where 3 = frequently, 2 = sometimes and 1 = never. The questions were asked in exactly the same format for both attending physicians and residents (Fig. 1). For each of the 15 questions, the scores of the attending staff were compared with those of the residents, using the Wilcoxon signed-rank test for ordinal data.

Next, the students were asked to give their overall rating of the clerkship using a 10-point scale, where 1 = weak and 10 = excellent.

The fourth group of questions was designed to assess the importance of residents in either improving or teaching medical students to perform clinical skills such as tying knots, suturing and inserting central lines. A 5-point scale was used, where 1 = not important and 5 = very important (Fig. 1).

The fifth group of questions assessed the importance of residents in either improving or teaching medical students about basic principles of general surgery such as fluid and electrolytes, wound healing and surgical bleeding. Again, a 5-point scale was used, where 1 = not important and 5 = very important (Fig. 1).

The sixth group of questions evaluated the importance of various people and activities on the students' learning experience. Students were asked to rank 10 modalities in terms of how much of their learning was achieved through that specific modality, with 1 = least important and 10 = most important (Fig. 1). For these last 3 groups of questions, item comparison was achieved with Dunn's multiple comparison test.

The last group of questions asked the students to describe the influence that residents had on their attitude toward general surgery as a career, and what appeal the lifestyle of surgical residents had on them. It also asked students to identify (marking either yes or no) if certain personal traits were found in the residents with whom they worked. The traits inquired about

**Question 1**

Regarding the **attending physicians** on your surgical services, how frequently did they exhibit the following teaching behaviours towards you?

	Frequently	Sometimes	Never
1. Provided a valuable teaching experience	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Served as a role model	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Provided sufficient exposure and availability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Showed respect for me as a person and a valuable member of the team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Discussed my patients in adequate depth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Stimulated me to do additional reading	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Taught me to be more analytical	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Improved my physical diagnosis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Provided guidance to appropriate journals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Taught at the bedside	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Discussed my clinical skills with me	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Utilized my talents sufficiently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Improved my physical history-taking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Was well prepared in teaching rounds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Provided adequate input in conferences/discussions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Question 2**

Regarding the **residents** on your surgical services, how frequently did they exhibit the following teaching behaviours towards you?

	Frequently	Sometimes	Never
1. Provided a valuable teaching experience	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Served as a role model	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Provided sufficient exposure and availability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Showed respect for me as a person and a valuable member of the team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Discussed my patients in adequate depth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Stimulated me to do additional reading	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Taught me to be more analytical	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Improved my physical diagnosis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Provided guidance to appropriate journals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Taught at the bedside	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Discussed my clinical skills with me	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Utilized my talents sufficiently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Improved my physical history-taking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Was well prepared in teaching rounds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Provided adequate input in conferences/discussions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Question 3**

Please give an overall rating of your 8-week surgical clerkship using this 10-point scale, where 1 = weak and 10 = excellent:

Weak									Excellent
1	2	3	4	5	6	7	8	9	10

**Question 4**

In assessing clinical skills and patient-contact issues, how important were the residents on your surgical rotation in either improving or teaching you to perform the following: (1 = not at all, 5 = very important)

	Importance of surgical resident in improving or teaching me about:				
	None				Very
Tying knots	1	2	3	4	5
Assisting in the operating room	1	2	3	4	5
Suturing	1	2	3	4	5
Central lines	1	2	3	4	5
Nasogastric tube placement	1	2	3	4	5
Foley catheter placement	1	2	3	4	5
Removing cutaneous lesions	1	2	3	4	5
Casting	1	2	3	4	5
Physical examinations	1	2	3	4	5
Blood taking	1	2	3	4	5
Arterial blood gases	1	2	3	4	5
Dealing with emergency situations (codes, trauma, respiratory difficulties,...)	1	2	3	4	5
Surgical record keeping	1	2	3	4	5

**Question 5**

In assessing basic principles of Surgery, how important were the residents on your surgical rotation in either improving your knowledge or teaching you about the following: (1 = not at all, 5 = very important)

	Importance of resident:				
	None				Very
Fluid and electrolytes	1	2	3	4	5
Wounds and wound healing	1	2	3	4	5
Surgical bleeding	1	2	3	4	5
Nutrition	1	2	3	4	5
Burns	1	2	3	4	5
Surgical infections	1	2	3	4	5

**Question 6**

During your surgical clerkship, how much of your learning was achieved through each of the following **ten** modalities: (please rate each item from 1 to 10, where 1 = most important, 10 = least important)

Attending physician's teaching	_____
Residents' teaching	_____
Tutorials	_____
Operating room	_____
Independent reading/studying	_____
Seminars	_____
Ward/service rounds	_____
Other rounds	_____
(Grand rounds, trauma conference, GI, pathology, radiology, ...)	_____
Clinics (OPD)	_____
Nurse's teaching	_____

**Question 7**

How would you describe the influence that residents on your surgical rotation had on your attitude towards General Surgery as a career: (1 = very negative, 3 = no influence, 5 = very positive)

Very negative		No influence		Very positive
1	2	3	4	5

**Question 8**

What appeal does the lifestyle of surgical residents have on you?

Very negative		No influence		Very positive
1	2	3	4	5

**Question 9**

In assessing the characteristics of the residents on your surgical rotations, how would you rate them as being:

1. Helpful	yes	no	no opinion
2. Available	yes	no	no opinion
3. Good teachers	yes	no	no opinion
4. Respectful of patients	yes	no	no opinion
5. Role models	yes	no	no opinion

**Question 10**

Which hospital were your surgery rotations in? \_\_\_\_\_  
Which rotations did you do? \_\_\_\_\_

**FIG. 1.** Questionnaire given to fourth-year medical students at the end of their 8-week surgical clerkship to determine their perceptions of the teaching behaviours of attending physicians and surgical residents.

were availability, helpfulness, respect toward patients, and whether or not the residents were good teachers and role models (Fig. 1).

In total, 97 forms were completed by the senior class totalling 123 students, for a response rate of 79%. Response to the questionnaire was voluntary, no students' names were collected in order to assure anonymity. All statistical values were calculated with the use of InStat and Microsoft Excel computer programs.

**RESULTS**

Mean scores for the 15 questions inquiring about attending physician and resident teaching behaviours revealed that in all 15 teaching behaviours except 1, residents were felt to be significantly more active than the attending staff ( $p < 0.05$ ) (Table I). Mean (and standard deviation) satisfaction with the clerkship was 6.31 (2.15) out of 10.

On a series of 13 clinical and technical skills, surgical residents were seen as more important in teaching medical students about suturing, assisting in the operating room, dealing with emergency situations, nasogastric tube placement, knot tying and insertion of Foley catheters. They were viewed as less important in some skills such as surgical record keeping, arterial blood-gas sampling and physical examination skills. They were significantly uninvolved in other skills such as applying casts, removing cutaneous lesions, central line placement and taking blood (Table II).

Concerning basic principles of surgery, residents were viewed as most important in teaching medical students about surgical infections. They were less important in teaching about surgical bleeding, wound healing, and fluid and electrolytes. Students felt that residents were uninvolved in teaching about nutrition and burns (Table III).

In describing the importance of various teaching modalities, students felt that 4 modalities were very important, 2 were equivocal and 4 were of less value. The 4 most important modalities were independent reading/studying, tutorials, residents' teaching and seminars. The 2 equivocal modalities were ward/service rounds and the operating room. The 4 least important modalities were clinics, other rounds, attending physicians' teaching and nurses' teaching (Table IV).

Medical students described the influence that residents had on their attitude toward general surgery as a career as a slightly positive one (3.40 out of 5) ( $p = 0.007$ ) (hypothetical mean 3), whereas their lifestyle had a negative appeal for medical students (1.98 out of 5),  $p < 0.0001$ .

When asked about residents' personal traits, students stated that most were helpful, available and good teachers, but fewer were either re-

**Table I**

**Comparison of Attending Physicians and Residents in Frequency of Teaching Behaviours**

Teaching behaviour	Attending	Resident	p value
Provided a valuable teaching experience	2.08 (0.51)	2.58 (0.58)	< 0.001
Served as a role model	1.98 (0.66)	2.49 (0.62)	< 0.001
Provided sufficient exposure and availability	1.91 (0.58)	2.62 (0.55)	< 0.001
Showed respect for me as a person and a valuable member of the team	2.08 (0.68)	2.56 (0.60)	< 0.001
Discussed my patients in adequate depth	1.51 (0.61)	2.42 (0.62)	< 0.001
Stimulated me to do additional reading	2.00 (0.67)	2.15 (0.68)	NS
Taught me to be more analytical	1.78 (0.73)	2.19 (0.67)	< 0.001
Improved my physical diagnosis	1.66 (0.67)	2.11 (0.71)	< 0.001
Provided guidance to appropriate journals	1.30 (0.53)	1.59 (0.69)	< 0.001
Taught at the bedside	1.66 (0.71)	2.19 (0.69)	< 0.001
Discussed my clinical skills with me	1.41 (0.58)	1.95 (0.76)	< 0.001
Utilized my talents sufficiently	1.78 (0.61)	2.19 (0.60)	< 0.001
Improved my physical history-taking	1.40 (0.62)	2.00 (0.71)	< 0.001
Was well prepared in teaching rounds	2.16 (0.71)	2.42 (0.58)	0.005
Provided adequate input in conferences/discussions	2.18 (0.68)	2.39 (0.61)	< 0.01

Scores are reported as raw means (and standard deviations) out of 3.

**Table II**

**Importance of Surgical Residents in Teaching Clinical Skills**

Skill	Mean score (and SD)
Suturing	3.51 (1.19)
Assisting in the operating room	3.47 (1.12)
Dealing with emergency situations	3.32 (1.18)
Nasogastric tube placement	3.25 (1.30)
Tying knots	3.11 (1.29)
Foley catheter placement	2.99 (1.45)
Surgical record keeping	2.88 (1.21)
Arterial blood gas sampling	2.85 (1.52)
Performing physical examinations	2.72 (1.16)
Blood taking	2.63 (1.36)
Inserting central lines	2.60 (1.47)
Removing cutaneous lesions	2.22 (1.40)
Applying casts	2.18 (1.42)

Scores are raw means out of 5.

spectful of their patients or served as role models (Table V).

**DISCUSSION**

The main purpose of this study, to assess the role of surgical residents in teaching medical students, appears to be addressed by the first 2 sections of this survey. Table I highlights the direct comparison of attending physicians and residents in frequency of teaching behaviours. The significantly higher scores given to residents based on our questionnaire supports the frequency of their interaction with medical students but cannot allow any in-

ference as to the quality or importance of the material taught. Reasons for which the residents may have scored better are probably owing to several mechanisms of the surgical clerkship. First, students spend much more time interacting with residents than they do with attending physicians because of the nature of the inpatient services at McGill University. This correlates with other surgical programs, where residents have been found to spend up to 25% more time than faculty members in training undergraduate medical students.<sup>10,11</sup> Second, students are more likely to view residents as peers. In that sense, residents may be more accessible and perhaps less threatening, so that students may feel more comfortable discussing certain topics with them than with attending staff. Third, staff are involved in a more didactic teaching process, focussing on important theories and basics of general surgery. The teaching done by residents usually involves more technical and practical aspects, directly related to specific patients and their problems. This is similar to problem-based learning, which encourages students to develop the schema necessary for memory recall.<sup>12</sup>

With certain clinical and technical skills, along with basic surgical principles, this survey suggests that residents have an interactive role to play with the medical student. Residents appear to serve as an important link between the theory and practice of surgery to clinical clerks, often teaching them important “survival skills.” Although it is difficult to assess the quality and quantity of teaching offered by residents, students identified certain areas as more important than others. If a program were established to teach residents about teaching, these areas would serve as important points of focus to ensure an adequate knowledge base within the resident group. This idea of “quality control” could be incorporated into the residency training program in one of several ways. A clinical teaching retreat<sup>5</sup> has met with some success in internal medicine, where residents reported significant improvement in several educational categories after these sessions. A similar type of retreat in pediatric medicine has been popular at the University of Massachusetts.<sup>13</sup> Also meeting with success has been a teaching rotation for residents, where they participate in additional instructional teaching methods, medical-student teaching and computer-based literature searches during a 1-month rotation.<sup>6</sup>

It is interesting that students identified resident-based teaching as the third most important learning modality, after independent reading and tutorials. This is perhaps the strongest

**Table III**

**Importance of Surgical Residents in Teaching Basic Principles of Surgery**

	Mean score (and SD)
Basic principle	
Surgical infections	3.48 (1.07)
Surgical bleeding	3.00 (1.03)
Fluid and electrolytes	2.80 (1.05)
Wounds and wound healing	2.77 (1.03)
Burns	2.25 (1.08)
Nutrition	2.21 (1.04)

Scores are raw means out of 5.

**Table IV**

**Importance of Various Teaching Modalities**

Activity	Mean score (and SD)
Independent reading/studying	6.10 (3.30)
Tutorials	6.10 (2.66)
Resident teaching	5.74 (2.66)
Seminars	5.31 (2.27)
Ward/service rounds	4.98 (2.24)
Operating room	4.98 (2.14)
Clinics	4.48 (2.60)
Other rounds (grand rounds, trauma conference, gastrointestinal, pathology, radiology...)	4.33 (2.25)
Attending physicians' teaching	3.80 (2.72)
Nurses' teaching	3.25 (3.11)

Score is given as a rank from 1 to 10, where 1 is least important and 10 is most important.

**Table V**

**Students' Perceptions of Residents**

Category	Perception, %		
	Yes	No	No opinion
Helpful	85.6	8.2	6.2
Available	81.4	13.4	5.2
Role models	55.7	26.8	17.5
Good teachers	77.3	17.5	5.2
Respectful	66.0	20.6	13.4

finding in this study to quantify the importance of the surgical resident in providing a significant learning experience. For the clerkship director, this question points to various areas in which the clerkship may benefit from improvement. For example, since nurses' teaching assumes a low priority in the students' learning process, improving this component of their clerkship will be of least benefit. However, stimulating the students to read while improving tutorials and residents' teaching should yield the greatest improvements.

The final group of questions attempted to yield insight into the attitudes that surgical residents may foster in their students' minds. Although it is encouraging that residents had a positive influence on their students' feelings toward surgery, it is disappointing that the lifestyle of these same residents had a negative influence. More troublesome, however, is that only 66% of students felt that their residents were respectful of patients. Although only 56% of students perceived the residents as role models, this is not unusual given that these are essentially peer groups. The fact that 86%, 81% and 77% of students felt that residents were helpful, available and good teachers, respectively, is encouraging.

Data from this study have shown that in our institution surgical residents have an important role in several areas of medical students' teaching, specifically in skills acquisition. Their teaching is the third most important teaching modality available to students. However, most residents have very little teaching background, which may hinder their abilities to seize upon good teaching opportunities. In addition, this study has confirmed the high level of frequency with which surgical residents are involved in teaching activities. Although this aspect is perceived to be significantly higher than the attending physicians' involvement, no inferences as to the

quality of the teaching can be made. It does, however, support the premise that residents should be taught how to teach, how to take better advantage of limited time, how to explore different teaching styles and how to acquire specific teaching techniques.<sup>13</sup> As already mentioned, several modalities exist to do this. Since residents are most likely to improve student learning through clinical precepting with brief lectures,<sup>14</sup> the course content of a teaching retreat or rotation should be designed accordingly. Using the information derived from this study and other published reports,<sup>15</sup> we have since undertaken a randomized prospective study to evaluate the effects of a teaching skills workshop for surgical residents. Like many other areas, some residents will prove to be natural teachers and others will not. Only then can the lesser teachers be made acceptable and the good teachers molded into excellent ones.

Special thanks are extended to Gloria Morgan, Rita Piccione and Nettie Epstein for their diligent work in data collection.

## References

1. Schwartz RW, Donnelly MB, Young B, Nash PP, Witte FM, Griffen WO Jr. Undergraduate surgical education for the twenty-first century. *Ann Surg* 1992;216(6):639-47.
2. Johnson CE, Bachur R, Priebe C, Barnes-Ruth A, Lovejoy FH Jr, Hafler JP. Developing residents as teachers: process and content. *Pediatrics* 1996; 97(6 Pt 1):907-16.
3. Yedidia MJ, Schwartz MD, Hirschhorn C, Lipkin M Jr. Learners as teachers: the conflicting roles of medical residents. *J Gen Intern Med* 1995;10:615-23.
4. Wipf JE, Pinsky LE, Burke W. Turning interns into senior residents: preparing residents for their teaching and leadership roles. *Acad Med* 1995; 70:591-6.
5. Litzelman DK, Stratos GA, Skeff KM. The effect of a clinical teaching retreat on residents' teaching skills. *Acad Med* 1994;69(5):433-4.
6. Mitchell S, Cook J, Densen P. A teaching rotation for residents. *Acad Med* 1994;69(5):434.
7. Barth RJ Jr, Rowland-Morin PA, Mott LA, Burchard KW. Communication effectiveness training improves surgical resident teaching ability. *J Am Coll Surg* 1997;185:516-9.
8. Dunnington GL, DaRosa D. A prospective randomized trial of residents-as-teachers training program. *Acad Med* 1998;73(6):696-700.
9. Xu G, Brigham TP, Veloski JJ, Rodgers JF. Attendings' and residents' teaching role and students' overall rating of clinical clerkships. *Med Teach* 1993;15(2-3):217-22.
10. Franzini L, Low MD, Proll MA. Using a cost-construction model to assess the cost of educating undergraduate medical students at the University of Texas-Houston Medical School. *Acad Med* 1997;72(3):228-37.
11. Goodwin MC, Gleason WM, Kontos HA. A pilot study of the cost of educating undergraduate medical students at Virginia Commonwealth University. *Acad Med* 1997;72:211-7.
12. DeVolder ML, de Grave WS. Schema training in problem-based learning. *Teach Learn Med* 1989;1(1):16-20.
13. Roberts KB, DeWitt TG, Goldberg RL, Scheiner AP. A program to develop residents as teachers. *Arch Pediatr Adolesc Med* 1994;148(4):405-10.
14. Wilkerson L, Lesky L, Medio F. The resident as teacher during work rounds. *J Med Educ* 1986;61:823-9.
15. Spickard A 3d, Corbett EC Jr, Schorling JB. Improving residents' teaching skills and attitudes toward teaching. *J Gen Intern Med* 1996;11:475-80.