Using Cognitive Mapping to Define Key Domains for Successful Attending Rounds

Brita Roy, MD, MPH, MS[1], Analia Castiglioni, MD[2,3], Ryan R. Kraemer, MD[2], Amanda H. Salanitro, MD, MS, MSPH[4,5], Lisa L. Willett, MD[6], Richard M. Shewchuk, PhD[7], Haiyan Qu, PhD[7], Gustavo Heudebert, MD[3,8], and Robert M. Centor, MD[2,3,9]

[1]University of Alabama at Birmingham Department of Internal Medicine, Birmingham, AL, USA; [2]Division of General Internal Medicine, University of Alabama at Birmingham, Birmingham, AL, USA; [3]Birmingham VA Medical Center, Birmingham, AL, USA; [4]Department of Veterans Affairs, Tennessee Valley Healthcare System Geriatric Research, Education and Clinical Center (GRECC), Nashville, TN, USA; [5]Section of Hospital Medicine, Vanderbilt University, Nashville, TN, USA; [6]Department of Medicine, Division of General Internal Medicine, Birmingham, AL, USA; [7]Department of Health Services Administration, School of Health Professions, University of Alabama at Birmingham, Birmingham, AL, USA; [8]University of Alabama at Birmingham School of Public Health, Birmingham, AL, USA; [9]UAB Huntsville Regional Medical Campus, Huntsville, AL, USA.

BACKGROUND: Ward attending rounds are an integral part of internal medicine education. Being a good teacher is necessary, but not sufficient for successful rounds. Understanding perceptions of successful attending rounds (AR) may help define key areas of focus for enhancing learning, teaching and patient care.

OBJECTIVE: We sought to expand the conceptual framework of 30 previously identified attributes contributing to successful AR by: 1) identifying the most important attributes, 2) grouping similar attributes, and 3) creating a cognitive map to define dimensions and domains contributing to successful rounds.

DESIGN: Multi-institutional, cross-sectional study design.

PARTICIPANTS: We recruited residents and medical students from a university-based internal medicine residency program and a community-based family medicine residency program. Faculty attending a regional general medicine conference, affiliated with multiple institutions, also participated.

MAIN MEASURES: Participants performed an unforced card-sorting exercise, grouping attributes based on perceived similarity, then rated the importance of attributes on a 5-point Likert scale. We translated our data into a cognitive map through multi-dimensional scaling and hierarchical cluster analysis.

KEY RESULTS: Thirty-six faculty, 49 residents and 40 students participated. The highest rated attributes (mean rating) were "Teach by example (bedside manner)" (4.50), "Sharing of attending's thought processes" (4.46), "Be approachable—not intimidating" (4.45), "Insist on respect for all team members" (4.43), "Conduct rounds in an organized, efficient & timely fashion" (4.39), and "State expectations for residents/students" (4.37). Attributes were plotted on a two-dimensional cognitive map, and adequate convergence was achieved. We identified five distinct domains of related attributes: 1) *Learning Atmosphere*, 2) *Clinical Teaching*, 3) *Teaching Style*, 4) *Communicating Expectations*, and 5) *Team Management*.

CONCLUSIONS: We identified five domains of related attributes essential to the success of ward attending rounds.

Attending rounds (AR) form the clinical educational cornerstone for internal medicine training.[1] AR provide faculty an opportunity for exchanging information, illustrating communication skills, and demonstrating appropriate clinical decision making. However, performing each of these tasks effectively and simultaneously is challenging. Although the hospital environment offers many opportunities for learning and demonstration, distractions and interruptions complicate daily ward rounds. Additionally, the rapidly growing wealth of applicable medical knowledge and inclusion of learners at different stages of training add to the complexity of this activity; few other instructional settings include learners at both the beginning and end of a training path.[2] Attending physicians also shoulder responsibility for delivering the highest quality of patient care. Adding even more complexity, recent changes in resident work-hour restrictions and competing educational and service obligations demand that AR must be performed efficiently.[3]

With these competing demands, we need a manageable, teachable framework for conducting successful rounds. Ward attending physicians currently receive little instruction or guidance on providing innovative and evidence-based instruction to all levels of trainees, exemplifying empathetic, patient-centered communication skills, and delivering high-quality patient care in an efficient and cost-effective manner,

all within a highly complex environment. Although techniques for achieving excellence in clinical teaching and role-modeling have been described,[2,4–12] most were published prior to the institution of work-hour regulations, and few include the perspective of resident and student learners.

This study introduces a framework of essential features for successful attending rounds, thus providing a guide for attending physicians who seek to improve their overall rounding performance. One could use this framework to improve ward rounds at the individual or departmental level by identifying domains of importance for successful rounds and providing specific examples to achieve excellence within each of these domains.

In a previous multi-institutional study, we elicited 30 attributes that learners self-identified as important for successful rounds from structured focus groups of resident physicians.[13] While this list is comprehensive of all aspects of AR, its length makes it cumbersome for practical use. Therefore, in the present study, we used consumer preference techniques to organize the contextual complexity of these defined components of successful AR, and thus tailor a framework based on the values and perspectives of the participants themselves.

METHODS
Identification of Attributes of Successful Rounds

We used data from our previous studies,[13,14] in which interns and residents from five internal medicine residency programs across the country participated in internet-based nominal group technique (NGT) sessions, to generate a total of 70 attributes that contributed to successful ward attending rounds.

The NGT is an established, structured, multi-step, facilitated group meeting technique used to elicit and prioritize responses to a specific question.[15] This highly structured format promotes equal rates of participation, equally weights input from all participants, and controls extraneous discussion.[16] Data generated by this process is quantitative, objective, and prioritized.

Investigators (AHS, AC, RMS, LLW, RMC) reduced the original list of 70 attributes through a formal process, combining substantively similar statements and eliminating redundant statements, resulting in 30 attributes describing successful rounds. Attributes were randomly numbered and are listed in Table 2.

Participants and Study Design

Faculty and trainees were recruited separately to participate in this cross-sectional study. Faculty participants were recruited at the April 2008 Southern Society of General Internal Medicine meeting. All faculty registered for this meeting were invited to participate. Participation was voluntary, and no incentives were provided.

Resident and student participants were recruited from two separate residency training programs: (1) a university-based internal medicine and internal medicine-pediatrics residency training program in Birmingham, AL, and (2) a community-based family medicine residency training program in Huntsville, AL. Invitations to participate were sent to all trainees in each residency program and to all medical students rotating on an internal medicine service at both of these residency programs during October-November, 2009. Participation was voluntary, and no compensation was provided for participating. The Institutional Review Board at the University of Alabama at Birmingham approved this study.

Card Sorting Exercise

After providing basic demographic data, participants performed an unforced card-sorting exercise. Each participant received a set of 30 cards labeled with each of the attributes of successful AR. We instructed participants to individually examine the attributes on the cards and to group the attributes they felt were similar using their own personal criteria of how specific characteristics fit together. They were allowed to generate two to ten piles, with each pile containing at least two cards. No themes or names were given to the piles. Faculty participants performed card sorting on-site at the regional meeting, or after the meeting and returned via mail. Residents and students performed the exercise at their respective institutions.

Next, we asked participants to rate the relative importance of each attribute by "its importance in contributing to successful attending rounds". Rating was performed on a 5-point Likert scale, ranging from "1–Not important at all" to "5–Extremely important." An additional choice, labeled "Don't understand," was also provided.

Analysis

We analyzed data from the unforced card-sorting exercise using multi-dimensional scaling (MDS),[17] followed by hierarchical cluster analysis (HCA),[18] in order to create a visual interpretation of the underlying psychological dimensions of the attributes by placing them onto a "cognitive map." To do this, we first constructed a 30 x 30 co-occurrence matrix from the piles created by each participant. For any two attributes, allotment into the same group by the participant was translated into a binary distribution (0 for not being in the same group, and 1 for being in the same group). The individual participants' co-occurrence matrices were then aggregated for all participants to create a group co-occurrence matrix. Numbers within the group matrix represented the frequency that two attributes were placed within the same pile.

We then applied MDS (ASCAL algorithm in SPSS) to the group co-occurrence matrix. MDS is an iterative process, used to create an optimal geometric solution, or "cognitive map", for the frequency of co-occurrence of the full set of attributes. This map is a spatial representation of the relationship between attributes: the relative proximity of any two points (each point representing one of the 30 attributes) is an approximation of the perceived similarity between those two attributes. The space itself can be uni-dimensional or multi-dimensional, and the appropriate number of dimensions is determined by choosing the solution that maximizes the R-square (RSQ) and reduces the stress statistic, in addition to overall interpretability of the map. The closer the RSQ is to 1.0, the better the map corresponds to the actual proximity data. Generally, an RSQ>0.90 suggests high correspondence. As the number of dimensions increase, the RSQ will increase; however, the map becomes more difficult to interpret. The stress statistic is an estimate of the "badness of fit," or a gauge of how forced the solution is, with a stress statistic>0.20 corresponding to poor fit, and a stress statistic<0.01 suggesting a degenerate solution. Therefore, acceptable MDS solutions have an RSQ>0.90 and a stress statistic between 0.01 and 0.20. If more than one possible solution meets these criteria, then the most interpretable configuration is chosen.

HCA is another iterative, multivariate statistical technique that further facilitates interpretation of the MDS-derived map, by demarcating clusters of related attributes within the space of the cognitive map. We input the coordinates corresponding to each point on the map from the MDS analysis into the HCA algorithm, which iteratively sought a best solution for grouping. We then analyzed the agglomeration schedule to determine the optimal number of clusters. The clusters identified by the HCA iterations were then visually delineated on the cognitive map by encircling each cluster of attributes within the MDS-derived space. The final empirically derived map is a visual expression of how participants cognitively organize the attributes contributing to successful AR.

MDS and HCA are non-parametric statistics, and consequently the validity of these analyses are independent of sample size. Validity is determined by convergence of the data, and is a function of how well the group participating in the card-sorting exercise represents the population sampled.[19]

Although the position and grouping of attributes on the map is algorithmically determined, the meaning underlying the dimensions, or axes, of the map and clusters demarcated on the map, is subject to interpretation. Thus, a group of co-investigators (BR, AC, RRK, LLW, GH, and RMC) collectively examined the overall similarity of attributes aggregated into a given cluster, and additionally compared the differences between attributes that fell on the extremes of each dimension. Current literature and texts were reviewed, and because no prior terminology fit the elucidated clusters well, ideas regarding the themes for each of the clusters and dimensions were discussed, and a consensus was reached for the label of each cluster and dimension, respectively.

RESULTS

We recruited 125 participants: 36 (29 %) faculty from various institutions in the Southeastern United States, 49 (39 %) residents and 40 (32 %) students from the Birmingham and Huntsville campuses of the University of Alabama (Table 1). Seventeen (14 %) were assistant professors, nine (7 %) were associate professors, and five (4 %) were full professors. Thirty-six (29 %) of the participants were internal medicine residents and 12 (10 %) were family medicine residents.

The overall importance of the individual attributes is shown in Table 2. The highest rated attributes (mean) on a Likert scale ranging from 5 (most important) to 1 (least important) were "Teaching by example (e.g. good bedside manner)" (4.50), "Sharing of attending's thought processes" (4.46), "Be approachable—not intimidating" (4.45), "Insist on respect for all team members" (4.43), "Conduct rounds in an organized, efficient & timely fashion" (4.39), and "State expectations for residents/students" (4.37). When trainee and faculty responses were analyzed separately, we found that trainees rated "Sharing of attending's thought processes" (4.42) as the most important attribute, while faculty rated "Be approachable—not intimidating" (4.74) as most important.

Cognitive maps based on data from the card sorting exercises performed by faculty were similar to those based on data from trainees (not shown). Thus, the data was combined, and the MDS algorithm was used to create a cognitive map based on the full data set (Fig. 1). Results from the MDS algorithm yielded three possible solutions:

Table 1. Demographics

Participant Demographics	N=125 (%)
Training Level/Category	
Full Professors	5 (4)
Associate Professors	9 (7)
Assistant Professors	17 (14)
Internal Medicine Residents	36 (29)
Family Medicine Residents	12 (10)
Third-year Medical Students	40 (32)
Gender	
Men	69 (55)
Women	52 (42)

Faculty were recruited from a regional general medicine conference, and residents and students were recruited from two campuses of the University of Alabama at Birmingham (Huntsville and Birmingham, AL), 2008-2009

Table 2. Domains for Successful Ward Attending Rounds

DOMAINS AND ATTRIBUTES	Mean Rating		
	Faculty	**Trainees**	**Overall**
Domain 1: Learning Atmosphere			4.11
Be approachable—not intimidating (1)	4.74	4.34	4.45
Insist on respect for all team members (16)	4.71	4.32	4.43
Showing enthusiasm (2)	4.65	3.92	4.13
Showing appreciation of team members for work performed (5)	4.35	3.89	4.02
Giving positive and negative feedback to all team members (12)	4.26	3.92	4.02
Allow room for mistakes (28)	3.97	3.98	3.98
Encourage a serious but relaxed atmosphere (13)	3.79	3.74	3.79
Domain 2: Clinical Teaching			4.10
Teaching by example (ie. good bedside manner) (8)	4.71	4.43	4.50
Sharing of attending's thought processes (4)	4.44	4.47	4.46
Setting aside time to teach (9)	4.06	4.15	4.12
Ensure attendings have a comprehensive knowledge base (19)	3.85	4.22	4.12
Integrate theory with actual patients and findings (18)	3.71	4.04	3.97
Teaching throughout rounds (3)	3.68	4.04	3.93
Discuss pathophysiology in relation to treatment plan (14)	3.62	4.00	3.89
Discuss relevant, evidence-based studies and literature (20)	3.78	3.82	3.81
Domain 3: Teaching Style			3.80
Ask questions of team about decisions (what and why) (15)	4.38	3.97	4.08
Have part of rounds at bedside, demonstrate key physical findings (22)	3.79	4.14	4.08
Having succinct teaching points (11)	3.91	3.94	3.93
Focus more on teaching than "getting the work done" (25)	3.03	3.12	3.09
Domain 4: Communicating Expectations			3.63
Stating expectations for residents/students (6)	4.59	4.29	4.37
Allow team some independence in decision-making (7)	4.41	4.02	4.13
Seek more patient feedback (29)	3.06	3.01	3.03
Ensure no interruptions until presentations are finished (24)	3.03	3.02	3.02
Domain 5: Team Management			3.63
Conduct rounds in an organized, efficient, & timely fashion (17)	4.47	4.36	4.39
Having a consistent, coherent plan of care (10)	4.26	4.21	4.22
Address appropriate discharge plans for & with each patient (26)	3.94	3.77	3.81
Allow time on rounds for residents to meet other responsibilities (21)	3.12	3.86	3.64
Select some cases to present in full and abridge others (27)	3.76	3.52	3.59
Write orders while rounding (30)	2.41	3.28	3.03
Having sit-down rounds before seeing patients (23)	2.44	2.87	2.75

Attributes within each domain, organized by mean ratings of perceived importance by 125 general medicine faculty, internal medicine and family medicine residents, and medical students (2008–09) on a 5-point Likert scale (1-not important at all, 5-extremely important). In parentheses are randomly assigned numbers corresponding to points on the cognitive map

one-dimensional solution (RSQ=0.903; stress=0.178), two-dimensional solution (RSQ=0.973; stress=0.085), and three-dimensional solution (RSQ=0.983; stress=0.062). The two-dimensional solution was chosen because of its superior interpretability. Results from the HCA revealed five groups of cognitively similar attributes, and are plotted on the map in Fig. 1. Adequate convergence of data was achieved.

After examination of the attributes within distinct clusters, the cluster in the upper portion of the map, containing attributes such as "Conduct rounds in an organized, efficient, and timely fashion," and "Allow time on rounds for residents to meet other responsibilities," was labeled *Team Management* (Fig. 1; Table 2). The cluster on the middle–right portion of the map, which included "Stating expectations for residents/students," and "Allow team some independence in decision-making," was named *Communicating Expectations*. The cluster on the bottom–right quadrant included "Be approachable—not intimidating," and "Insist on respect for all team members," and was titled *Learning Atmosphere*. The large cluster in the

bottom–left quadrant was comprised of the attributes "Teaching by example (e.g. good bedside manner)," and "Sharing of attending's thought processes," was labeled *Clinical Teaching*. Finally, we titled the cluster on the middle–left portion of the map *Teaching Style*, as it contained the attributes "Ask questions of the team about decisions (what and why)," and "Have part of rounds at bedside, demonstrate key physical findings." Four of the clusters contained at least one of the six highest rated attributes.

We conceptualized the vertical or y-axis to represent different attending roles: the superior portion of the map included attributes such as "write orders while rounding," and "address appropriate discharge plans for & with each patient," which was felt to fit the attending role of *Manager*, and the inferior portion of the map included attributes such as "be approachable, not intimidating," and "teaching by example," which describe the attending role of *Clinician*. The x-axis represents intrinsic attending attributes, with the left side of the x-axis associated with *Knowledge*, since attributes relating to discussion of pathophysiology and
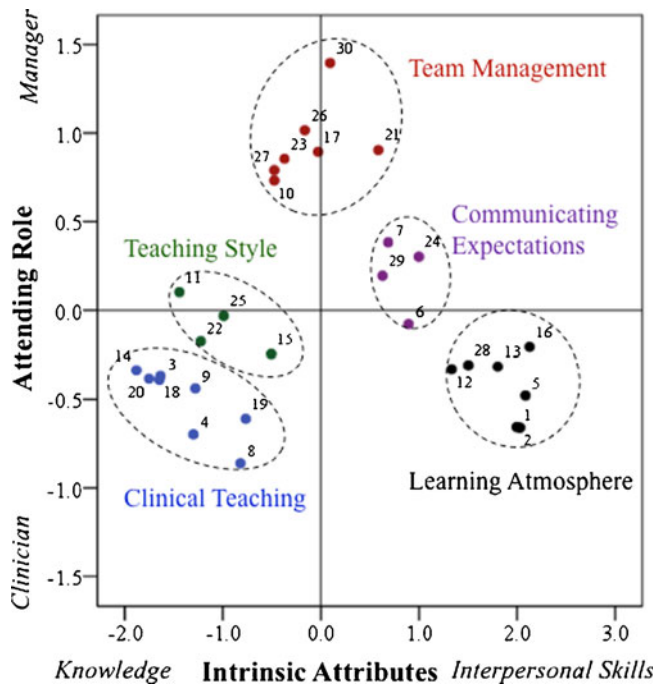
Figure 1. Cognitive map: empirically derived visual representation of 30 attributes identified as important for successful rounds. Each number corresponds to one of 30 attributes listed in Table 2. The two-dimensional solution is portrayed, with each axis and dimension interpreted and labeled accordingly. Five unique clusters or domains of attributes were identified and encircled, and were also interpreted and labeled based on similarities of attributes within the domain.

evidence-based medicine aggregated along this side of the map, and the right side is correlated with *Interpersonal Skills*, since attributes such as "Insist on respect," and "Show appreciation for team members and work performed," lie on this portion of the map. Highest rated attributes were spread fairly symmetrically across each axis.

DISCUSSION

Using multi-dimensional scaling and hierarchical cluster analysis, we developed a visual representation of the domains and dimensions of attributes used to describe successful ward attending rounds. This analysis identifies five complementary yet distinct domains, or clusters of similar attributes, that both learners and attending physicians judged contributory to successful rounds: *Learning Atmosphere*, *Clinical Teaching*, *Teaching Style*, *Communicating Expectations*, and *Team Management*. We mapped the attributes across a two-dimensional space with attending roles of "manager" and "clinician", and qualities of "knowledge" and "interpersonal skills" representing each of four orthogonal poles. The highest rated attributes spread symmetrically throughout the cognitive

map and are included in four different domains. This distribution highlights the importance of each dimension and domain, affirming the insufficiency of one-dimensional excellence—successful ward rounds require simultaneous mastery of interpersonal skills, knowledge, clinical excellence, and managerial skills.

This study differs from previous studies of teaching through our focus on the teaching session rather than the teacher. Previous studies have described the attributes of good teachers and the attributes of excellent attending-physician role models.[9,11] We hypothesized that these studies described necessary but insufficient skills to be successful in conducting ward rounds. Additionally, this study, unlike previous studies, used consumer preference techniques to study attending rounds. These techniques allow us to better define both attending and learner's expectations of AR. Including attending physicians, residents, and students from diverse training environments to develop our domains increases the generalizability of the domains and reduces potential bias we as educators alone might bring to the development of this framework. Our students and residents came from a large academic internal medicine program and a large community family medicine program, respectively, and participating faculty were from various institutions across the Southeastern US.

A guideline for medical teaching has been previously described by Skeff (2007). He has described seven categories of teaching: 1) creating a positive learning climate; 2) organizing control of the teaching session; 3) communication of educational goals; 4) promoting understanding and retention; 5) evaluation of the learner; 6) providing feedback; 7) fostering self-directed learning.[11] Additionally, Wright et al. (1998), defined five attributes of excellent clinical role models: 1) spending greater than 25 % of one's time teaching; 2) spending 25 or more hours per week teaching and conducting rounds; 3) stressing the importance of the doctor-patient relationship; 4) teaching the psychosocial aspects of medicine; 5) having served as a chief resident.[9] These two authors provide us with paradigms for teaching and role modeling, but ward attending rounds are not purely teaching sessions. Our findings are more current, informed by duty hour changes, and add an important concept to the study of ward attending rounds: learners perceive attending rounds as combined teaching and service sessions. While learners emphasize many attributes associated with teaching, they also focus on the process of patient care. Thus, ward attendings should use this unique opportunity to demonstrate clinical reasoning as well as exemplary patient care in an efficient, patient-centered manner.

Since ward attending rounds have multiple functions, the skills that learners expect are multi-dimensional, and ward attending physicians will succeed most if they develop

skills within all five domains. While learners want teaching, they want a defined amount each day. The six top ranked attributes support our formulation. While the top two attributes involved teaching, e.g. bedside manner and sharing thought processes, the other four did not specifically address teaching. One can find these attributes—being approachable, showing respect, organized rounds and stating expectations—on any good list of managerial skills. Learners do expect and seek teaching of various sorts: information, patient skills, and thought processes. They want expectations made explicit, and they desire a comfortable learning climate. Our study differs significantly from previous studies by emphasizing the domains encompassing clinical efficiency and time management. Our participants valued varied aspects of attending rounds, including conducting rounds in an organized, efficient and timely fashion.

Overall, cognitive maps were similar between faculty and learners (not shown), but priorities differed. While faculty believed "being approachable" and "bedside manner" were the most important attributes, learners placed the highest value on "sharing attending's thought processes." This phrase differs from the transfer of knowledge alone. Residents and medical students want to understand how experienced physicians arrive at their decisions. What our learners desired correlates with the recent strong emphasis on clinical reasoning in the educational literature.[20]

Our study has limitations. The results are generalizable only to internal medicine ward rounds, and evaluation of surgical rounds would likely result in vastly different priorities. Additionally, since participation was completely voluntary and without reward, our results may be biased if there was a difference between residents, students, and attendings electing to participate compared to those who did not. Although residents and students were all from the University of Alabama at Birmingham, the Birmingham and Huntsville campuses are completely separate and unique with regards to patient population, call schedule, and rounding style. Furthermore, faculty participants were from multiple institutions throughout the southern region of the US.

We believe this framework can help develop faculty-training programs and aid individual ward attendings in improving their performance on teaching rounds. Having a clear understanding of these five complementary, yet distinctly important, domains of successful ward rounds can provide a structure for attending physicians to reflect on their ward attending process. Defining these domains enables comprehension of this complex and critical multi-dimensional activity, and future work will focus on evaluation of ward rounds based on this framework. We add to the current literature by identifying the important concept of explicitly demonstrating clinical reasoning in an organized and efficient manner during daily ward attending rounds.

Corresponding Author: *Brita Roy, MD, MPH, MS; University of Alabama at Birmingham Department of Internal Medicine, Birmingham, AL, USA (e-mail: britaroy@uab.edu).*

REFERENCES

1. **Gonzalo J, Masters P, Simons R, Chuang C.** Attending rounds and bedside case presentations: medical student and medicine resident experiences and attitudes. Teach Learn Med. 2009;21(2):105–110.
2. **Ende J.** What if Osler were one of us? Inpatient teaching today. J Gen Intern Med. 1997;12(Suppl 2):S41–48.
3. **Harrison R, Allen E.** Teaching internal medicine residents in the new era. Inpatient attending with duty-hour regulations. J Gen Intern Med. 2006;21(5):447–452.
4. **Irby D.** Clinical teacher effectiveness in medicine. J Med Educ. 1978;53(10):808–815.
5. **Irby D.** What clinical teachers in medicine need to know. Acad Med. 1994;69(5):333–342.
6. **Kroenke K.** Attending rounds: guidelines for teaching on the wards. J Gen Intern Med. 1992;7(1):68–75.
7. **Mattern W, Weinholtz D, Friedman C.** The attending physician as teacher. N Engl J Med. 1983;308(19):1129–1132.
8. **McLeod P.** A successful formula for ward rounds. CMAJ. 1986;134(8):902–904.
9. **Wright S, Kern D, Kolodner K, Howard D, Brancati F.** Attributes of excellent attending-physician role models. N Engl J Med. 1998;339(27):1986–1993.
10. **Tariq M, Motiwala A, Ali S, Riaz M, Awan S, Akhter J.** The learners' perspective on internal medicine ward rounds: a cross-sectional study. BMC Med Educ. 2010;10(1):53.
11. **Skeff K.** The chromosomal analysis of teaching: the search for promoter genes. Trans Am Clin Climatol Assoc. 2007;118:123–132.
12. **Kroenke K, Simmons J, Copley J, Smith C.** Attending rounds: a survey of physician attitudes. J Gen Intern Med. 1990;5(3):229–233.
13. **Castiglioni A, Shewchuk R, Willett L, Heudebert G, Centor R.** A pilot study using nominal group technique to assess residents' perceptions of successful attending rounds. J Gen Intern Med. 2008;23(7):1060–1065.

14. **Salanitro A, Castiglioni A, Shewchuk R, et al.** Housestaff views on successful attending rounds: A multi-institutional study. *J Gen Intern Med.* 2007;22(S1).

15. **Miller D, Shewchuk R, Elliot TR, Richards S.** Nominal group technique: a process for identifying diabetes self-care issues among patients and caregivers. Diabetes Educ. 2000;26(2):305–310. 312, 314.

16. **Van de Ven A, Delbecq A.** The Nominal Group as a Research Instrument for Exploratory Health Studies. AJPH. 1972;62:3337–3342.

17. **Schiffman SS, Reynolds ML, Young FW.** Introduction to multidimensional scaling: theory, methods, and applications. New York: Academic Press; 1981.

18. **Aldenderfer MS, Blashfield RK.** Cluster analysis. Beverly Hills: Sage Publications; 1984.

19. **Speece D.** Methodological issues in cluster analysis: how clusters become real. In: Learning disabilities: Theoretical research issues. Hillsdale, NJ 1990:210–213.

20. **Kassirer JP.** Teaching clinical reasoning: case-based and coached. Acad Med. 2010;85(7):1118–1124.