Measuring Progressive Independence With the Resident Supervision Index: Empirical Approach

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Abstract

Background A Resident Supervision Index (RSI) developed by our research team quantifies the intensity of resident supervision in graduate medical education, with the goal of testing for progressive independence. The 4-part RSI method includes a survey instrument for staff and residents (RSI Inventory), a strategy to score survey responses, a theoretical framework (patient centered optimal supervision), and a statistical model that accounts for the presence or absence of supervision and the intensity of patient care.

Methods The RSI Inventory data came from 140 outpatient encounters involving 57 residents and 37 attending physicians during a 3-month period at a Department of Veterans Affairs outpatient clinic. Responses are scored to quantitatively measure the intensity of resident supervision across 10 levels of patient services (staff is absent, is present, participated, or provided care with or without a resident), case discussion (resident-staff interaction), and oversight (staff reviewed case, reviewed medical

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chart, consulted with staff, or assessed patient). Scores are analyzed by level and for patient care using a 2-part model (supervision initiated [yes or no] versus intensity once supervision was initiated).

Results All resident encounters had patient care supervision, resident oversight, or both. Consistent with the progressive independence hypothesis, residents were 1.72 ($P = .019$) times more likely to be fully responsible for patient care with each additional postgraduate year. Decreasing case complexity, increasing clinic workload, and advanced nonmedical degrees among attending staff were negatively associated with supervision intensity, although associations varied by supervision level.

Conclusions These data are consistent with the progressive independence hypothesis in graduate medical education and offer empirical support for the 4-part RSI method to quantify the intensity of resident supervision for research, program evaluation, and resident assessment purposes. Before informing policy, however, more scientific research in actual teaching settings is needed to better understand the relationships among patient outcomes, clinic workload, case complexity, and graduate medical education experience in resident supervision and professional development.

Background

The concept of graded responsibility for care and progressive independence from supervision has long been a model for graduate medical education (GME)[1–3] and has been incorporated into accreditation standards, policy statements, and supervision requirements.[4–7] However, no study to date has attempted to quantitatively estimate progressive independence in actual clinical settings as residents are promoted from one postgraduate year to the next.

The 4-part Resident Supervision Index (RSI) was developed to quantitatively measure and assess the intensity of resident supervision, which can be used to test for progressive independence. A prior article has described the feasibility and psychometric reliability of the RSI Inventory as a survey instrument to collect supervision information from attending staff and residents (APPENDIX 1),[8] and in the companion article published in this issue of *Journal of Graduate Medical Education*, we describe the theory of patient-centered optimal supervision and derive the 2-part analytic models designed to test theory-driven hypotheses.[9] In this article, we introduce the final part of the 4-part RSI method by describing how RSI Inventory responses are scored to compute supervision intensity.

To measure the intensity of resident supervision in patient care and to test for progressive independence, scores are computed for outpatient encounters with internal medicine residents who rotated through a Department of Veterans Affairs (VA) clinic in 2008. The RSI method is evaluated by testing 3 RSI theory-driven hypotheses, derived elsewhere,[9] in

TABLE 1 **Supervision Levels by Phase, With Participants and Resident Supervision Index (RSI) Data Sources**

Supervision Level	Attending Physician	Resident Physician	Patient	Questionnaire Source
	Resident Oversight Phase			
1.1 Patient assessed	Present	Absent	Present	[1(A)(i)] + [1(A)(iii)][a]
1.2 Clinical staff consulted	Present	Absent	Absent	[1(B)][a]
1.3 Medical chart reviewed	Present	Absent	Absent	[1(C)][a]
1.4 Case presented	Present	Present	Absent	[2(A)], [3(A)], [3(B)(*i*)–(*vi*)][b]
	Care Discussions Phase			
2.1 Interacted	Present	Present	...	[2(A)], [3(A)], [3(B)(*i*)–(*vi*)][b]
	Patient Services Phase			
3.1 Separately provided	Involved	Absent	Present	[2(C)][b]
3.2 Provided	Involved	Observed	Present	[2(B)(a)][b]
3.3 Participated	Involved	Involved	Present	[2(B)(b)(*i*)][b]
3.4 Observed	Observed	Involved	Present	[2(B)(b)(*ii*)][b]
3.5 Absent attending	Absent	Involved	Present	[2(B)(b)(*iii–v*)][b]

[a] From RSI Inventory version 4.01.
[b] From RSI Inventory version 3.11.

TABLE 2 **Definitions and Computation Formulas for Phase and Encounter Resident Supervision Index (RSI) Summary Scores**

Variable[a]	Explanation
	Patient Services Phase
Definition	Proportion of patient services phase when resident was directly supervised
Formula	$RSI_{serv} = 1 - [(1 - RSI_{3.1}) \times (1 - RSI_{3.2}) \times (1 - RSI_{3.3}) \times (1 - RSI_{3.4})]$
	Care Discussions Phase
Definition	Proportion of patient care involving care discussions[b]
Formula	$RSI_{disc} = RSI_{2.1}$
	Resident Oversight Phase
Definition	Proportion of encounter time involving resident oversight
Formula	$RSI_{over} = 1 - [(1 - RSI_{1.1}) \times (1 - RSI_{1.2}) \times (1 - RSI_{1.3}) \times (1 - RSI_{1.4})]$
	Patient Care[b]
Definition	Proportion of patient care time when resident was directly supervised
Formula	$RSI_{care} = 1 - [(1 - RSI_{serv}) \times (1 - RSI_{disc})]$
	Patient Care Responsibility[c]
Definition	Proportion of patient care time when resident was providing care and attending physician was absent from the room, computed after the attending physician was fully informed about the patient case
Formula	$RSI_{resp} = 1 - RSI_{care}$
	Encounter[d]
Definition	Proportion of encounter time when resident was directly supervised
Formula	$RSI_{enc} = 1 - [(1 - RSI_{serv}) \times (1 - RSI_{disc}) \times (1 - RSI_{over})]$

[a] For formulas, the supervision-level RSI scores are represented by RSI_l, where l designates the corresponding supervision level (1.1–3.4), defined in TABLE 1.
[b] Patient care includes encounter time during the patient service phase or care discussions phase.
[c] Defined in the text. Scores are computed based on the assumption that attending physicians are fully informed about each case, or effectively that $RSI_{over} = 0$.
[d] Encounter includes the patient service phase, care discussions phase, and resident oversight phase.

which the intensity of resident supervision is expected to decrease (1) for residents with longer lengths of GME training (progressive independence), (2) in clinics with more workload (workload effect), and (3) with patients who present with less complex medical problems (complexity effect).

Resident Supervision Index

Encounter

To score RSI data, clinical activities in teaching clinics are divided into supervision encounters containing interactions among a resident, an attending physician, and the services they provide to a given patient. Services can be defined as narrowly as a clinical procedure or as broadly as an acute episode of care. For this study, encounters are defined by outpatient visit.

Levels and Phases

Listed in TABLE 1, each encounter can be segmented into 3 clinical phases ordered sequentially over time, beginning with resident oversight, when attending physicians gather information to assess patient progress, monitor resident performance, and evaluate clinical care. Resident oversight informs the second phase, care discussions, when the attending physician interacts with the resident to discuss the patient's case to inform the third phase, patient services, when the attending physician and resident perform medical procedures. Care discussions and patient services combine to form patient care, distinct from oversight. Phases may run intermittently during an encounter as residents and attending physicians go back and forth between oversight, discussions, and providing services.

Phases are further segmented into levels representing degrees of supervision intensity. During the resident oversight phase, attending physicians collect information by assessing the patient in separate examinations, by consulting with clinical staff, by reviewing the medical chart, and by asking residents to give case presentations. During the care discussions phase, attending physicians interact with

TABLE 3 **Demographics, Use of Inpatient and Outpatient Care, and Diagnoses of Study Patients**

Variable	Value (n = 136)
Age, y	
Mean (SD) [range]	63 (11) [24–91]
Age group, No. (%)	(n = 136)
<25	1 (1)
25–34	1 (1)
35–44	2 (1)
45–54	23 (17)
55–64	55 (40)
≥65	54 (40)
Sex, No. (%)	(n = 136)
Female	7 (5)
Male	129 (95)
Annual income, $1000, No. (%)	(n = 128)
00–24	75 (59)
25–49	48 (38)
50–74	1 (1)
75–99	3 (2)
≥100	1 (1)
Priority status veteran, No. (%)[a]	(n = 136)
Priority	119 (88)
Other	17 (13)
Health insurance coverage, No. (%)	(n = 136)
Private health insurance	60 (44)
None	76 (56)
Outpatient care[b]	(n = 136)
Day of encounter	
Procedures per user, mean (SD) [range]	3.1 (3.0) [1–19]
30 Days before encounter	
Initiated care, No. (%)	101 (74)
Visits per user, mean (SD) [range]	2.9 (2.2) [1–17]
Clinic stops per user, mean (SD) [range]	4.5 (3.8) [1–24]
Procedures per user, mean (SD) [range]	9.3 (8.2) [1–43]
30 Days after encounter	
Initiated care	103 (76)
Visits per user, mean (SD) [range]	3.0 (2.1) [1–15]
Clinic stops per user, mean (SD) [range]	4.8 (4.0) [1–23]
Procedures per user, mean (SD) [range]	9.7 (7.9) [1–41]
Inpatient care	(n = 136)
90 Days before encounter	
Initiated care, No. (%)	16 (12)
Admissions per user, mean (SD) [range]	1.2 (0.6) [1–3]
Bed sections per user, mean (SD) [range]	1.6 (0.9) [1–4]
Days per user, mean (SD) [range]	3.6 (2.5) [1–8]
30 Days after encounter	
Initiated care, No. (%)	11 (8)
Admissions per user, mean (SD) [range]	1.0 (0.0) [1–1]
Bed sections per user, mean (SD) [range]	1.6 (1.2) [1–4]
Days per user, mean (SD) [range]	6.2 (4.9) [2–17]
Diagnoses or disorder classes[c]	(n = 135)
Day of encounter	
Diagnoses or disorder classes, mean (SD) [range]	2.90 (1.87) [1–8]
90 Days before and 30 days after encounter	
Diagnoses or disorder classes, mean (SD) [range]	7.10 (2.91) [1–13]
Diagnosis or disorder class, No. (%)	
Infectious (001–139)	25 (19)
Neoplasm (140–239)	25 (19)
Endocrine glands (250–259)	84 (62)
Metabolic or immunity (270–279)	67 (50)
Blood or organs (280–289)	27 (20)
Mental disorders (290–319)	74 (55)
Nervous/sense (320–389)	58 (43)
Hypertensive (401–405)	88 (65)
Heart disease (410–429)	47 (35)
Circulatory system (430–459)	27 (20)
Respiratory system (460–519)	32 (24)
Digestive system (520–579)	48 (36)

TABLE 3 **Continued**

Variable	Value (n = 136)
Genitourinary system (580–629)	39 (29)
Skin (680–709)	24 (18)
Musculoskeletal (710–739)	69 (51)
Ill defined (780–799)	68 (50)
Injury or poisoning (800–999)	19 (14)

[a] Department of Veterans Affairs–defined priority levels 1 through 4.
[b] Clinic stop refers to different clinics the patient attends during an outpatient visit.
[c] *International Classification of Diseases, Ninth Revision* (ICD-9) diagnoses by class based on 3-digit codes. Congenital anomalies (codes 740–759) and conditions originating in perinatal period (760–779) were excluded.

residents to change care, order tests, or direct services. During the patient services phase, attending physicians may separately provide care when residents are physically absent or provide care when residents are present to observe. When residents are providing care, the attending physician may either participate in care, observe care, or be absent from the room but otherwise available in the clinic or on call.

In addition to oversight, attending physicians may become informed when engaged in the patient's care or during care discussions with residents. An activity is classified as oversight, however, whenever its sole purpose is to gather information about the case. Encounter minutes that can be classified simultaneously into 2 phases are to be classified by the later phase. For example, time the attending physician spends simultaneously collecting information (resident oversight phase) and directing care (care discussions phase) would be classified as care discussions.

Scores

Based on theory of patient-centered optimal supervision,[9] intensity scores are computed for each of 10 levels listed in TABLE 1, the 3 phases, patient care, and encounter. Case examples are given in APPENDIX 2.

Residents supervised at the least intensive level (staff absent from the room [level 3.5]) are said to have "no direct supervision" during that encounter moment. The score is measured in minutes and is represented symbolically by $[RSI_{3.5}]$. Scores for the remaining 9 "directly supervised" levels ($[RSI_{1.1}]$, $[RSI_{1.2}]$,...$[RSI_{3.4}]$) are measured as time proportions, with the numerator equal to the time at the given level and with the denominator equal to the sum of time over all levels of equal or lesser intensity plus the time at all later phases. Scores for directly supervised levels range between 0 and 1, with higher scores indicating more intensive supervision. Scores are calculated so that the time when the resident was supervised at a given level and phase is compared only with time during the encounter when the resident was at an equal or lesser level of supervision intensity, or at a later phase. Thus, higher scores are associated with more minutes in the given level, fewer minutes in levels of lesser intensity during the same phase, and fewer minutes in later phases. Scores are computed to weigh each moment at a given level against the rest of the time during the encounter when the resident experienced less, not more, intensive supervision.

Summary scores can be computed by phase, for patient care, and for the encounter. Formulas and definitions are given in TABLE 2. The summary score for the encounter $[RSI_{enc}]$ equals the proportion of total encounter time when the resident was directly supervised. We define responsibility for care as 1 minus the intensity of resident supervision. As intensity of supervision decreases from 1 to 0, the intensity of assigned responsibility for patient care increases from 0 to 1. If supervision intensity equals the proportion of encounter time when the resident was directly supervised, then responsibility represents the proportion of encounter time when the resident provided care with staff absent from the room. Our theoretical framework is based on the assumption that attending physicians are fully informed about the case (oversight) when supervising residents for care discussions and patient services.[9] We thus compute patient care responsibility $[RSI_{resp}]$ after staff oversight as follows:

$$(1)\quad RSI_{resp} = 1 - (RSI_{enc} \mid RSI_{over} = 0)$$

$$(2)\quad = 1 - \{1 - [(1 - RSI_{serv}) \times (1 - RSI_{disc}) \times (1 - \{RSI_{over} = 0\})]\}$$

$$(3)\quad = [(1 - RSI_{serv}) \times (1 - RSI_{disc})]$$

$$(4)\quad = 1 - RSI_{care}$$

During an encounter, residents are said to be (1) (a) directly supervised at level l if the resident is supervised at level l during any encounter moment ($RSI_l > 0$) or (b) autonomous from supervision at level l if otherwise ($RSI_l = 0$), (2) directly supervised for the encounter whenever the resident is supervised during any encounter moment at any of 9 directly supervised levels ($RSI_{enc} > 0$), (3) (a) autonomously providing care ($RSI_{care} = 0$) or (b) fully responsible for care ($RSI_{resp} = 1$) whenever attending staff did not hold care discussions and was absent from the room throughout resident-provided patient services, or (4) unattended if the resident was autonomously providing care and was without resident oversight ($RSI_{enc} = 0$). Fully responsible residents ($RSI_{care} = 0$) are not unattended ($RSI_{enc} > 0$) if they receive oversight ($RSI_{over} > 0$).

Methods

Data

The analyses use data from the VA RSI feasibility trial. The trial shows that RSI Inventory version 3.11 is both feasible and reliable in collecting information about time spent during supervision encounters, as described by Byrne et al.[8]

TABLE 4 **Demographic, Specialty, and Medical Education Characteristics of Responding Resident Physicians and Attending Physicians**

Characteristic	Resident Physicians (n = 57)	Attending Physicians (n = 37)
Age, y	(n = 55)	(n = 37)
Mean (SD) [range]	32 (5) [25–46]	43 (9) [30–61]
Age group, No. (%)		
<25	0	0
25–34	41 (75)	10 (27)
35–44	11 (20)	10 (27)
45–54	3 (5)	12 (32)
55–64	0	5 (14)
≥65	0	0
Sex, No. (%)	(n = 56)	(n = 37)
Female	24 (43)	12 (32)
Male	32 (57)	25 (68)
Race/ethnicity, No. (%)	(n = 52)	(n = 35)
African American	3 (6)	5 (14)
Asian	22 (42)	20 (57)
Latino	1 (2)	1 (3)
Middle Eastern	4 (8)	0
Native American	5 (10)	1 (3)
White	17 (33)	8 (23)
Time since college graduation, mean (SD) [range], y	9 (5) [4–26]	21 (9) [8–40]
Time since medical school graduation, y	(n = 46)	(n = 37)
Mean (SD) [range]	5 (6) [0–22]	17 (9) [4–39]
Range group, No. (%)		
1–4	22 (48)	3 (8)
5–9	14 (30)	9 (24)
10–14	4 (9)	4 (11)
15–19	4 (9)	7 (19)
20–24	2 (4)	8 (22)
25–29	0	2 (5)
≥30	0	4 (11)
Medical school location, No. (%)	(n = 56)	(n = 37)
United States	30 (54)	28 (76)
Non–United States	26 (46)	9 (24)
US residency, No. (%)		

TABLE 4 **Continued**

Characteristic	Resident Physicians (n = 57)	Attending Physicians (n = 37)
Current or completed postgraduate year level[a]	(n = 56)	(n = 36)
1	22 (39)	0
2	16 (29)	0
3	15 (27)	19 (53)
4	1 (2)	10 (28)
5	0	2 (6)
6	1 (2)	5 (14)
7	1 (2)	0
Specialty	(n = 56)	(n = 37)
Internal medicine	47 (84)	33 (89)
Preventive medicine	2 (4)	0
Surgery	4 (7)	4 (11)
Psychiatry	2 (4)	0
Podiatry	1 (2)	0
Entered non-US residency, No. (%)	(n = 57)	(n = 37)
Yes	6 (11)	4 (11)
No	51 (89)	33 (89)
Advanced nonmedical degree, No. (%)	(n = 57)	(n = 37)
Master's or doctorate	12 (21)	6 (16)
No	45 (79)	31 (84)

[a] Postgraduate year level represents a resident's current status in a graduate medical education program and for attending staff represents the last postgraduate year level successfully completed.

Briefly, after receiving 1-day training for the manualized RSI Inventory instrument by study investigators and under supervision by the associate chief of staff for education, 2 registered nurses and 3 clinical care coordinators interviewed consenting attending staff and their consenting residents rotating through primary care general internal medicine clinics at the Jerry L. Pettis Memorial VA Medical Center, Loma Linda, California, from May through September 2008. Under a VA Institutional Review Board–approved protocol, the RSI Inventory was administered at the end of the resident's shift for patient encounters selected at random from among scheduled clinic appointments. Patients were limited to those who had a diagnosis of diabetes or major depression. These diagnoses are highly prevalent among VA patients, and the patients often present with moderate case complexity. The RSI scores were computed based on resident responses only.

Patient care demographics, *International Classification of Diseases, Ninth Revision* (ICD-9) diagnosis codes, and inpatient and outpatient care information were obtained from the VA's electronic databases.[10,11] Demographic, education, and GME information were obtained from self-reports during baseline interviews with residents and their attending physicians.

The length of the resident's current GME program was measured in months, but effect sizes were reported in years. Case complexity was computed as the number of ICD-9 clinical conditions reported in the patient's medical chart for the indexed visit that aggregated into 1 of 17 mutually exclusive and exhaustive disorder classes (TABLE 3). Case complexity was further refined by including data about patients' private health insurance coverage derived from the VA's electronic medical chart. Results of prior studies[11,12] suggested that VA patients with private health insurance coverage are in overall better health and require less complex care than VA patients without private insurance. Workload by shift was computed by the number of procedures performed in the clinic during each shift per available attending staff.

TABLE 5 **Number of Encounters when the Resident was Supervised, and Mean Resident Supervision Index (RSI) Score among Supervised Residents, by Supervision Level**[a]

Supervision Level	Outpatient Encounters, No. (%) (n = 140)	RSI Score, Mean (SD) [Range]
	Resident Oversight Phase	
Case presented	90 (64)	0.23 (0.11) [0.02–0.50]
	Care Discussions Phase	
Interacted	45 (32)	0.23 (0.09) [0.05–0.40]
	Patient Services Phase	
Separately provided	0	…
Provided	10 (7)	0.19 (0.16) [0.05–0.50]
Participated	35 (25)	0.24 (0.12) [0.04–0.60]
Observed	2 (1)	0.17 ([d]) [0.17–0.18]
Absent attending[b]	140 (100)	27.2 (11.7) [5–65]
	Summary Scores	
Patient care responsibility	72 (51)	0.28 (0.14) [0.05–0.75]
Encounter[c]	140 (100)	0.28 (0.13) [0.02–0.75]

[a] Residents were supervised when RSI > 0 by supervision level or summary.
[b] Absent-attending level is measured in minutes, or time attending physician was absent (ie, not physically present in the examination or treatment room) while the resident provided care.
[c] Patient care summary (RSI_{care}) combines the patient services phase and care discussions phase. Encounter summary (RSI_{enc}) combines the patient services phase, care discussions phase, and resident oversight phase to comprise the entire encounter. Oversight included only resident case presentations and does not include oversight from medical chart review, staff consultation, or patient assessments, as data were not collected.
[d] Indicates too few cases to compute.

Analyses

The association between length of GME training and RSI supervision intensity is computed using a 2-part model.[9] An exhaustive search was used within each covariate category to identify potential confounders.[13] With complex 4-way interactions between resident, attending physician, patient, and clinic shift, we assumed that supervision intensity was independently distributed over 140 encounters. The length of time when residents provided care with an absent attending ($RSI_{3.5}$) was regressed using a log linking function, with exponentiated coefficients measuring effect sizes as simple time ratios.

Results

Fifty-seven residents (TABLE 4) and 37 attendings (TABLE 4) cared for 136 patients (TABLE 3) during 140 encounters from May through September 2008. The mean (SD) daily workload over 137 shifts averaged 578 (36) patients and 2309 (189) procedures per day. The total mean (SD) time per encounter was 32.7 (14.8) minutes (range, 5–81).

TABLE 5 summarizes RSI scores by level of intensity. In 90 of 140 encounters (64%), residents presented the case to the attending staff, representing a mean of 23% of the total encounter time. The attending physician engaged in care discussions in 45 of 140 encounters (32%), consuming 23% of the total time devoted to patient care. By contrast, there were no encounters when care was provided while the resident was not present. Among patient services, 35 of 140 encounters (25%) involved an attending physician participating in care during 24% of the total time when the attending physician was participating, observing, or absent from care. In 72 of 140 encounters (51%), attending physicians directly supervised residents, accounting for 28% of the total time residents were providing care. Attending physicians directly supervised their residents for all 140 encounters so that no resident was left unattended ($RSI_{enc} = 0$).

TABLE 6 gives estimates of the associations between length of GME training and RSI supervision intensity adjusted for case complexity, clinic workload, and patient, resident, and attending physician characteristics. Consistent with the progressive independence hypothesis, residents who were advanced by 1 year in their GME training were only 58% as likely to have been directly supervised during a patient care encounter, or alternatively 1.72 (1 divided by 0.58) (95% confidence interval, 1.09–2.70) times more likely to be fully responsible for patient care. Greater responsibility for patient care (progressive independence) was the result of attending staff being less likely to participate in services or hold case discussions with

residents. However, once supervised, length of GME training had little statistically significant effect on the intensity of supervision. On the other hand, residents advanced by 1 year spent only 62% as much time providing care with attending staff absent than their lower-level counterparts. This is consistent with the theory that upper-level residents are more efficient producers of health care.

Patients who presented with more medical conditions were associated qualitatively with different levels of supervision, but not quantitatively with a higher intensity of supervision. Attending physicians who supervised residents for patients presenting with more conditions tended to be more likely to interact with the resident in care discussions but less likely to participate in providing care.

Residents treating patients with private health insurance were only 42% as likely to be supervised, with only 37% of the intensity once supervision began, than their counterparts who were treating uninsured patients. Supervision was less because their attending staff held fewer care discussions and participated less in patient care.

The quantity of workload facing clinic staff did not effect whether residents were supervised. However, once supervision began, residents were supervised at only 33% of the intensity as their counterparts who rotated through clinics where 100 fewer procedures were produced per day per attending physician. Supervision was less because attending staff participated less in patient care.

We also found that attending physicians with advanced degrees (other than medicine) were no more likely to initiate supervision. Once supervision began, degreed attendings supervised with only 24% of the intensity as their non-degreed counterparts, a consequence of degreed staff participating less in patient care. A resident's foreign medical graduate status had little effect on the likelihood or intensity of supervision.

Discussion

In this study, residents in internal medicine were granted more autonomy from supervision in a VA outpatient clinic as they progressed through GME training. Our data also showed more intensive supervision when residents faced more complex patients in clinics with greater workloads. Such findings offer empirical support for an RSI method. Quantifying supervision and measuring progressive responsibility have policy implications for defining supervision standards and measuring GME educational outcomes.[14]

Building on previous work,[1–3,15] the RSI method consists of a survey instrument (RSI Inventory),[8] scoring strategy (presented herein), theoretical framework (patient-centered optimal supervision),[9] and analytic framework (2-part model).[9] This article shows how RSI Inventory responses were scored to quantify different levels of supervision intensity that, taken together, profile supervision during encounters among residents, attending physicians, and patients in outpatient care settings. Our data provide support for the RSI method by showing intensity scores covarying with resident experience, complexity of patient cases, clinic workload, and attending physician characteristics, consistent with the patient-centered theory of optimal supervision.

Supervision has often been described as an oversight function designed to ensure the quality of care[15,16] and measured by whether the attending physician made a medical chart notation,[17] was physically present,[18] was involved,[19,20] identified discrepancies,[21] or participated on the health team.[22] In contrast, the RSI defines supervision broadly to include resident oversight, interactive discussions, and attending involvement. To test for progressive independence, we calculated scores that quantified progressive responsibility separately from resident oversight so that residents could be assigned full responsibility for patient care, while remaining under faculty oversight to inform appropriate supervision decisions. In fact, almost half of the VA encounters studied were full-care responsibility assignments with attending oversight.

The RSI method may serve as a tool to help GME directors evaluate a resident's progress toward independence. In recent years, the medical education community has adopted the Accreditation Council for Graduate Medical Education general competencies and learning objectives associated with them to assess residents' competence. At the same time, some have argued that, while competencies have advanced assessment in GME, competency evaluations do not measure clinical performance based on what physicians actually do in practice.[23–25] Some have noted that the general competency approach risks diverting GME assessment away from actual clinical performance by deconstructing clinical competence into demonstrations of knowledge, skill, and learning objectives.[24] By contrast, clinical performance requires the integration and application of all 6 competencies and their application to complex context-specific clinical scenarios.[26,27] Therefore, clinical competence may be best assessed through residents' performance of clinical activities and judged by expert clinicians who are familiar with the resident's clinical performance. In fact, a resident's supervisor may be the best judge of a resident's progress toward practice independence.[28,29] While these judgments are subjective, potentially biased, and limited by a lack of direct observation,[26] the collective judgment of faculty over the course of a resident's training may provide a measure to assess a resident's clinical competency.[24] Furthermore, few validated tools are available to directly observe trainees' skills and to track the progress of clinical skill development.[30] Progressive independence as measured by the RSI relies on the supervisor's judgment about the resident's clinical competencies in situations when his or her first duty is to represent the interest of the patient. Therefore, the RSI potentially provides an opportunity to quantify those judgments as a measure of progression to practice independence, the ultimate educational goal of GME.

TABLE 6 **Adjusted Effect of Predictors on the Likelihood and Intensity of Supervision for Patient Care and Selected Supervision Levels**[a]

	Direct Supervision (Yes or No) (*RSI* > 0 versus *RSI* = 0)[b]			Supervision Intensity (*RSI* given *RSI* > 0)[c]		
Variable	**OR (95% CI)**	**Wald Statistic**	***P* Value**	**OR %Δ (95% CI)**	***t* Statistic**	***P* Value**
	Length of GME Training[d]					
Patient care	0.58 (0.37–0.92)	5.42	.019	0.75 (0.51–1.11)	2.32	.103
Interacted	0.44 (0.26–0.74)	9.50	.002	1.10 (0.76–1.59)	0.79	.49
Participated	0.59 (0.35–1.01)	3.71	.054	0.61 (0.34–1.08)	2.76	.070
Absent attending	…	…	…	0.62 (0.39–0.98)	2.52	.045
	Diagnoses or Disorder Classes[e]					
Patient care	1.02 (0.85–1.22)	0.04	.85	1.25 (0.90–1.72)	1.66	.15
Interacted	1.25 (1.02–1.54)	4.32	.038	1.19 (0.87–1.61)	1.37	.22
Participated	0.71 (0.55–0.93)	5.94	.015	1.22 (0.81–1.82)	1.18	.28
Absent attending	…	…	…	0.90 (0.68–1.21)	0.87	.42
	Private Health Insurance					
Patient care	0.42 (0.21–0.86)	5.55	.018	0.37 (0.18–0.76)	3.36	.015
Interacted	0.41 (0.18–0.93)	4.64	.031	0.44 (0.22–0.88)	2.90	.027
Participated	0.48 (0.20–1.12)	2.89	.089	0.40 (0.16–1.01)	2.43	.051
Absent attending	…	…	…	1.50 (0.78–2.89)	1.52	.18
	Workload[f]					
Patient care	0.79 (0.42–1.49)	0.54	.46	0.33 (0.16–0.69)	3.69	.010
Interacted	0.89 (0.45–1.79)	0.10	.75	0.56 (0.28–1.12)	2.03	.089
Participated	0.53 (0.25–1.12)	2.76	.097	0.26 (0.10–0.65)	3.58	.012
Absent attending	…	…	…	3.29 (1.71–6.33)	4.45	.004
	Advanced Nonmedical Degree[g]					
Patient care	0.34 (0.10–1.11)	3.20	.074	0.24 (0.10–0.76)	3.03	.023
Interacted	0.42 (0.11–1.67)	1.50	.22	0.60 (0.20–1.85)	1.11	.31
Participated	0.58 (0.14–2.38)	0.56	.45	0.09 (0.02–0.40)	3.96	.007
Absent attending	…	…	…	2.36 (0.83–6.73)	2.01	.092
	Non-US Medical School[h]					
Patient care	0.55 (0.26–1.15)	2.57	.11	1.05 (0.51–2.17)	0.19	.86
Interacted	0.69 (0.31–1.56)	0.79	.38	0.93 (0.46–1.85)	0.28	.79
Participated	0.60 (0.25–1.41)	1.38	.24	1.25 (0.50–3.13)	0.59	.58
Absent attending	…	…	…	0.51 (0.27–0.98)	2.52	.045

Abbreviations: CI, confidence interval; GME, graduate medical education; ICD-9, International Classification of Diseases, Ninth Revision; OR, odds ratio; RSI, Resident Supervision Index.

[a] Adjusting for case complexity (number of medical conditions at indexed outpatient visit), patient characteristics (patient has private health insurance coverage), resident length in GME training, whether resident is US versus international medical school graduate, attending physician with an advanced master's or doctorate degree in addition to medical degree, clinic workload based on number of procedures during day of indexed outpatient visit per staff physician per 100 procedures.

[b] Direct supervision is presented as a binary variable representing supervision (yes or no) for the patient care phase ($RSI_{care} = 0$ versus $RSI_{care} > 0$), attending interaction level ($RSI_{2.1} = 0$ versus $RSI_{2.1} > 0$), and participated in care level ($RSI_{3.3} = 0$ versus $RSI_{3.3} > 0$). Effect size is measured as an OR for the likelihood that the resident was supervised at any time during a given level or phase, per encounter.

TABLE 6 **Continued**

[c] The RSI scores measure the intensity of supervision given the resident was supervised for the patient care phase (RSI_{care} given $RSI_{care} > 0$), attending interaction level ($RSI_{2,1}$ given $RSI_{2,1} > 0$), and participated in care level ($RSI_{3,3}$ given $RSI_{3,3} > 0$). Effect size is measured as an OR describing the change in RSI scores, which was computed as a proportion. The %Δ is the change in absent-attending care minutes computed as a simple ratio. For example, 0.62 means the resident spent 62% fewer minutes providing absent-attending care for each additional year of GME training.
[d] Resident length of GME training computed in program years.
[e] Number of ICD-9 conditions, aggregated into 1 of 17 disease classes, presented during the indexed outpatient visit. Conditions in the same class were counted only once.
[f] Workload measured in procedures per 100 performed in the clinic during the 24-hour day corresponding to the indexed outpatient visit associated with the supervision encounter, by MD or DO professional staff.
[g] Attending physician has an earned advanced degree (master's or doctorate degree) in addition to a medical degree versus no nonmedical advanced degree.
[h] Resident physician has an earned medical degree from an international (non-US) medical school versus from a US medical school.

The present study has several limitations. Study data were derived from a single site. Patient use of non-VA sources of care and resident rotations to non-VA facilities were not considered. The study did not measure the appropriateness, quality, or efficiency of resident supervision, nor did it include measures of quality of care or patient health outcomes. Further theoretical and empirical research is recommended.

Conclusions

Data on resident supervision at a VA outpatient clinic offer empirical support for the progressive independence hypothesis and for the 4-part RSI method. The RSI was designed to measure the intensity of resident supervision for research, program evaluation, and resident assessment purposes. An important advantage of RSI scores is that they do not need to be adjusted for patient outcomes, but only if supervisors aim first and foremost to maximize patient outcomes and residents contribute to patient care. Before informing policy, however, more scientific research in actual teaching settings is needed to better understand the relationships among patient outcomes, clinic workload, complexity of assigned cases, and GME experience in resident supervision and professional development.

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APPENDIX 1

Resident Supervision Index – Inventories

RSI-I *ver*. 3.11

RESIDENT SUPERVISION INDEX

Responder: ☐ -Resident. ☐ -Attending Physician. ☐ -Other:_____.

Date Beg: ___/___/___|___:___ am / pm (mm dd yy hr min) Date End: ___/___/___|___:___ am / pm (mm dd yy hr min)

[pres_nam] Resident: _____ [pres_id] _____

[pphy_nam] Attending Physician: _____ [pphy_id] _____

[0a] ☐ **None** [ppat_nam] Patient: _____ [ppat_id] _____

[0b] ☐ ***Resident-attending encounter***

1. For how many minutes was this case discussed with attending? min: _____

1(A). How was this case discussed (check one)?

[i] ☐ face-to-face /group. [iv] ☐ telephone.

[ii] ☐ face-to-face /individual. [v] ☐ patient's chart.

[iii] ☐ telemedicine /video confer. [vi] ☐ email/letter/text message.

1(B). For what purpose was this case discussed (check all)?

[i] ☐ case generally, [iii] ☐ chart review or test result,

[ii] ☐ patient call / email / letter, [iv] ☐ prior patient encounter.

[0c] ☐ ***Resident-attending-patient encounter***

2(A). Outside the presence of the patient, how many minutes did the resident discuss the case with the attending? min: _____

2(B). In the presence of the patient, how many minutes did resident spend:

2(B)(a). observing only? min: _____

2(B)(b)- in direct contact with patient while the attending was…

(*i*). in the room and participating in care? min: _____

(*ii*). in the room but not participating in care? min: _____

(*iii*). in the clinic area? min: _____

(*iv*). not in the clinic area but available by phone / pager? min: _____

(*v*). not available? min: _____

2(C). For how many minutes did attending spend time with the patient when the resident was not present? min: _____

☐ ***All encounters***

3(A). Did discussion contribute to case understanding? ☐ - yes ☐ - no

3(B)- Interaction with attending….	confirmed	changed	neither	not discussed
(*i*). patient's history?	☐	☐	☐	☐
(*ii*). examination findings?	☐	☐	☐	☐
(*iii*). interpretation of diagnostic testing?	☐	☐	☐	☐
(*iv*). diagnosis?	☐	☐	☐	☐
(*v*). assessment?	☐	☐	☐	☐
(*vi*). plan?	☐	☐	☐	☐

Interviewer: _____ DATE: mm_____/dd_____/yy_____ TIME: ____:____ am / pm. *ver*. 3.11

RSI-I *ver*. 4.01

RESIDENT SUPERVISION INDEX

Attending Physician

Responder: ☐ -Attending Physician. ☐ -Other:_____.

Date Beg: ___/___/___|___:___ *am pm* (mm dd yy | hr min) Date End: ___/___/___|___:___ *am pm* (mm dd yy | hr min)

[pres_nam] Resident: _____ [pres_id] _____

[pphy_nam] Attending Physician: _____ [pphy_id] _____

[0a] ☐ **None** [ppat_nam] Patient: _____ [ppat_id] _____

[0b] ☐ ***Attending oversight***

1. For how many minutes did the attending physician when the resident was not present:

1(A)- have direct contact with patient:

(*i*). to *oversee* resident care only? min: _____

(*ii*). to *provide* care only? min: _____

(*iii*). to *oversee* resident care and *provide* care? min: _____

1(B). talk to staff to oversee resident care? min: _____

1(C). review patient chart to oversee resident care? min: _____

[0c] ☐ ***Resident-attending-patient encounter***

2(A). Outside the presence of the patient, how many minutes did the resident discuss the case with the attending? min: _____

2(B). Did discussion contribute to case understanding? ☐ - yes ☐ - no

2(C)- Interaction with attending….	confirmed	changed	neither	not discussed
(*i*). patient's history?	☐	☐	☐	☐
(*ii*). examination findings?	☐	☐	☐	☐
(*iii*). interpretation of diagnostic testing?	☐	☐	☐	☐
(*iv*). diagnosis?	☐	☐	☐	☐
(*v*). assessment?	☐	☐	☐	☐
(*vi*). plan?	☐	☐	☐	☐

Interviewer: _____ DATE: mm_____/dd_____/yy_____ TIME: ____:____ am / pm. ver. 4.01

Appendix 2

Case Examples Computing Resident Supervision Index Scores

Case 1

A first-year resident examines a patient with dyspnea alone (15 minutes), suggests pleural effusion to the attending physician, who after discussion with the resident recommends a chest x-ray (9 minutes). The attending physician confirms the resident's interpretation of the x-ray and recommendation for thoracentesis (6 minutes). The attending physician performs the procedure, while the inexperienced resident observes (30 minutes). The attending physician reviews and signs the medical chart (3 minutes). The attending was absent from care for 15 minutes (level 3.5), 30 minutes providing care (level 3.2), 9 minutes interacting with residents to direct care (level 2.1), 6 minutes overseeing and confirming the resident's thoracentesis recommendation (level 1.4), and 3 minutes signing the patient's chart (level 1.3). Thus, absent-attending care $RSI_{3.5} = 15$ minutes, providing care $RSI_{3.2} = 30 / (15 + 30) = 0.67$, interaction $RSI_{2.1} = 9 / (15 + 30 + 9) = 0.17$, oversight case presentation $RSI_{1.4} = 6 / (15 + 30 + 9 + 6) = 0.10$, and oversight medical chart review $RSI_{1.3} = 3 / (15 + 30 + 9 + 6 + 3) = 0.05$. Patient care summary is $RSI_{care} = 1 - [(1 - 0.67) \times (1 - 0.17)] = 0.73$, indicating the resident was under direct supervision during 73% of patient care and was responsible for $RSI_{resp} = 27\%$, or $(1 - 0.73)$, of patient care. The encounter summary is $RSI_{enc} = 1 - [(1 - 0.67) \times (1 - 0.17) \times (1 - 0.10) \times (1 - 0.05)] = 0.77$, or the resident was under direct supervision during 77% of the encounter.

Case 2

Same as case 1, but a second-year resident orders the x-ray and recommends thoracentesis to the attending physician, who confirms both diagnosis and treatment plan (12 minutes). The resident also performs the thoracentesis with the physician watching (30 minutes). The attending physician continues to be absent for 15 minutes during patient services but now spends 30 minutes (level 3.4) observing the resident performing the thoracentesis. Attending-observed care $RSI_{3.4} = 0.0$ in case 1 increased to $RSI_{3.4} = 30 / (15 + 30) = 0.67$ in case 2, while attending-provided care $RSI_{3.2} = 0.67$ decreased to $RSI_{3.2} = 0$. That is, direct supervision shifted from the attending providing care to a lesser intensive attending observing the resident providing care. There is no attending interaction, with $RSI_{2.1}$ decreasing from 0.17 in case 1 to 0.0 in case 2. Oversight case presentation increased from 0.10 to $RSI_{1.4} = 12 / (15 + 30 + 12) = 0.21$. Oversight medical chart review remains essentially unchanged at $RSI_{1.3} = 1 / (15 + 30 + 12 + 3) = 0.05$. Patient care supervision decreased from 0.73 in case 1 to $RSI_{care} = 0.67$ and $RSI_{resp} = 1 - 0.67 = 0.33$ in case 2. Encounter supervision decreased slightly from 0.77 to $RSI_{enc} = 1 - [(1 - 0.67) \times (1 - 0.21) \times (1 - 0.05)] = 0.75$ in case 2.

Case 3

Same as case 2, but a third-year resident performs the thoracentesis without the attending physician present. Time for absent-attending care increased from 15 minutes to $RSI_{3.5} = 45$ minutes. Time for attending observing care decreased to $RSI_{3.4} = 0.00$, with attending interaction and oversight intensities unchanged. Thus, the intensity of supervision for patient care decreased from 0.67 to $RSI_{care} = 0.00$, with $RSI_{resp} = 1 - 0.00 = 1.00$. That is, the resident was autonomously providing patient care, with overall supervision for the encounter decreasing from 0.75 to $RSI_{enc} = 1 - [(1 - 0.21) \times (1 - 0.05)] = 0.25$.

Case 4

Same as case 3, but the attending physician tells the resident not to report back unless a problem occurs. Oversight case presentation decreased from 0.21 to $RSI_{1.4} = 0.00$, leaving supervision for the encounter to decrease from 0.25 in case 3 to $RSI_{enc} = 0.05$ in case 4.

Summary

Taken together, these 4 cases provide an example of how the increasing clinical competencies of a resident can lead to reduced intensity of supervision for patient care from 0.73 to 0.00, and for the encounter from 0.77 to 0.05, with assigned responsibility increasing from 0.27 to 1.00. From case 1 to case 4, residents were progressively assigned to full responsibility for patient care, while remaining supervised for the encounter.