

Clinical Performance Evaluations of Resident Physicians Using a Competency-Based Framework in China

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Abstract

Objective: To present an analysis of evaluation data from a competency-based resident evaluation framework in China.

Materials and Methods: The authors analyzed monthly clinical performance evaluations of all levels of resident physicians at a teaching hospital in Wuhan, China (n=3275). Clinical performance scores were aggregated in five core domains and analyzed by resident type (Faculty Track, Masters Track, and Standard Track), gender, and resident year. Chi square and multiple logistic regression analyses were performed to understand differences between the different groups of residents.

Results: Clinical performance scores increased from first-year residents to third-year residents, with significant increases in 12/15 domain scores across all resident types. Evaluation outcomes varied significantly between residents with varying backgrounds in academic level, training, and work experience, with significant differences in 10/15 domain scores across resident years. Overall, 24% (86/360) of competency domain scores in the graduating class did not meet graduation standards. Faculty Track residents were more likely to receive better clinical performance scores than Masters Track and Standard Track residents across multiple domains and resident year.

Conclusion: In one of the first analyses of competency-based resident assessments in China, the authors found evidence of progressive attainment of milestones by residents over time, with small differences depending on their training background. A substantial portion of residents in the graduating class received scores that did not meet graduation standards. For hospitals across China that include multiple resident types within the same programs, dedicated resources may be needed to address these imbalances for Masters Track and Standard Track residents.

Keywords: Competency-based medical education in China; Chinese residency programs; Resident performance evaluations

Abbreviations: CBME: Competency-Based Medical Education; PGY1: Post-Graduate Year 1; PGY2: Post-Graduate Year 2; PGY3: Post-Graduate Year 3

Introduction

As the world's most populous country, China has faced unique challenges in producing enough competent medical trainees to serve the needs of its vast patient population [1]. Ambitious policy initiatives, including goals to increase numbers of general practitioners from

84,800 in 2010 to 700,000 by 2030, have increased the demand on medical institutions to ensure training quality of large numbers of trainees [2].

The implementation of competency-based medical education (CBME), which utilizes an outcomes-based approach to design and evaluate training programs, represents an opportunity to address these challenges. CBME frameworks anchor medical training around the attainment of competencies, i.e. the core abilities necessary to provide strong medical care. This outcomes-based approach to training requires both defining the core competencies needed of medical trainees in a particular context, as well as creating assessment tools to measure trainees' progress towards these competencies [3]. In the 21st century, CBME has become the standard for developing proficient medical graduates, starting with Canada and the United States [4-6]. This standard is also reflected in residency training worldwide, as programs strive to develop and adapt models for effectively evaluating competencies of trainees [7]. In China, various medical schools have made efforts to develop CBME-based frameworks, but most have yet to integrate them into their residency training programs [8,9].

In recent years, China's national push for health reform has provided an opportune climate for the development of CBME-based frameworks in residency programs. Starting from China's ambitious health reform in 2009, medical institutions nationwide have revamped and standardized both undergraduate and graduate medical education [10]. China adopted a standardized "5+3" program in 2013, which mandated three years of residency training along with five years of undergraduate education for physicians, and issued guidelines for the standardization of these residency programs [11]. While this transition has presented an opportunity to introduce novel training frameworks based on clinical competencies, current national residency training standards are mainly based on knowledge and procedural skills [12,13]. For example, the Chinese national curriculum document currently outlines trainee education through lists of diseases and disease-specific skills to master for each specialty, with little consideration for broader competencies such as those involving communication, teamwork, and self-directed learning [14]. Additionally, surveys of residents have shown unfamiliarity with different competency categories, reflecting the current lack of a mature competency curriculum [15]. Future implementation of standards that represent the multidimensional competencies required in clinical practice may result in a broader education of residents, as was seen in other countries [16].

The assessment of the spectrum of physician competencies delineated in CBME frameworks has the potential to identify disparities in outcomes among the different resident types in China. One notable characteristic of China's medical education context is that many university-affiliated hospitals have three distinct resident types in training, each with different potential training needs [17]. By comparing measurements of outcomes in different groups, CBME approaches present an opportunity to identify, assess, and address these different needs. There is a need to study how competency frameworks should be implemented in this novel context, and how resources should be allocated to address disparities between types of residents [18-20].

This study analyses differences in clinical performance between resident types at a major Chinese university-affiliated hospital that has integrated a CBME framework into its evaluation infrastructure [21,22]. Some important questions to be addressed by this evaluation program were whether resident performance was comparable between the various types of residents, and whether residents met milestones for independent practice by graduation [23,24].

Materials and Methods

We conducted this study by analyzing data from monthly performance evaluations of resident physicians by supervising attending physicians at a Wuhan teaching hospital. The monthly assessment tool was designed by faculty at Zhongnan Hospital in Wuhan, China based on their competency outcomes framework, which consisted of five core competency domains (professionalism, communication and collaboration, patient care, scholarship, and systems engagement) of a physician. Assessment was based on milestones in each domain that were determined by the institution's medical education leadership.

Using this tool, teachers were instructed to assess residents' performance online each month based on daily work of trainees. From the five core domains, the monthly resident survey evaluated twelve competencies (Appendix 1), each of which has five milestones corresponding to the following standards: A=level expected of a medical school graduate, B=level expected of a first year graduate (PGY1) at the end of the first year, C=level expected of an end-of-year second year graduate (PGY2), D=level expected of an end-of-year third year graduate (PGY3) and thus a physician ready to practice independently, E=level of an excellent attending physician. Some excerpts of this evaluation tool for the Patient Care domain are included in Appendix 2. Prior to implementation of the evaluation tool, the instructors were trained on use of this tool and competency-based assessment, including topics such as the one-minute preceptor, direct observation of procedural skills (DOPS) evaluation, and effective feedback methods.

Regarding China's three types of residents, many Chinese academic medical institutions have Faculty Track, Masters Track, and Standard Track residents in training. Faculty Track residents have already completed a masters' or clinical doctorate degree in medicine prior to matriculation and Masters Track residents are enrolled in a combined masters' degree and residency program (Table 1).

The data were evaluated across resident type, resident year, and gender. For resident type analysis, PGY1, PGY2, and PGY3 were evaluated separately. A resident's score in each domain was calculated from the average of each of that domain's respective competency scores. Then, the data were evaluated by comparing the proportion of residents reaching the expected graduation standard across each resident type using a Chi-Square test. A similar process was performed for comparison of performances across resident year, performing a Chi-Square test for the proportion of residents reaching graduation standard for their respective resident type across resident year. Analysis on the proportion of students reaching graduation standard by gender was performed using multiple logistic regression. Gender, resident type, and year were included in the multivariable regression model. The data were analyzed using Stata MP 16 for Windows (Stata Corp, College Station, Texas). A P-value <.05 was considered as statistically significant. The research study was approved by the Institutional Review Board at the University of Chicago.

Results

All 3,275 resident evaluations at the Wuhan teaching hospital recorded during the 2018 calendar year were included. This reflected data from 690 residents across 24 different specialties and 41 rotation departments.

During the course of the year, the attending evaluation completion rate was 70.8%. Considering the huge patient care volumes in this teaching hospital, we regarded this response rate to be adequate for this study, and a strong start, though in the future we will aspire to >95% compliance.

The demographic characteristics of the study population are shown in Table 2. Most resident evaluatees were women (63%) and Masters Track residents (41%), and the majority of evaluations were conducted between April and November. Both PGY1 and PGY2 residents had higher numbers of evaluations than PGY3.

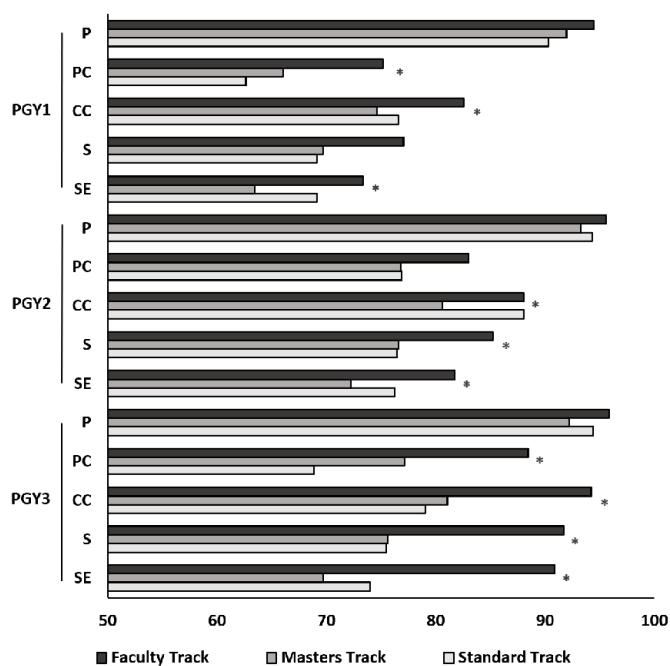
We analyzed the proportion of residents in each resident type reaching the level expected by graduation (Figure 1). Overall, 86% of Faculty Track resident evaluations, 78% of Masters Track resident evaluations, and 78% of Standard Track resident evaluations were at or above graduation standard. We found significant differences between PGY1 resident types in patient care, communication and collaboration, and systems engagement, with Faculty Track residents scoring highest in all categories. Between PGY2 resident types, we found significant differences in communication and collaboration, scholarship, and systems engagement, with Faculty Track residents scoring highest in all categories except for communication and collaboration, where Faculty Track and Standard Track residents reached graduation standard at the same proportion. Between PGY3 residents, we found significant differences in patient care, communication and collaboration, scholarship, and systems engagement, with Faculty Track residents scoring highest in all categories.

Table 2: Demographic Information Regarding Evaluations Received at a Teaching Hospital in Wuhan, China, 03/2018 to 12/2018.

Characteristic	Number (Percentage)
Evaluations (n=3275)	
<i>Gender</i>	
Male	1210 (37)
Female	2065 (63)
<i>Resident Type</i>	
Masters Track	1450 (44)
Faculty Track	709 (22)
Standard Track	1116 (34)
<i>Post-Graduate Year</i>	
PGY1	1100 (34)
PGY2	1346 (41)
PGY3	829 (25)
<i>Month</i>	
March	5 (<1)
April	346 (11)
May	316 (10)
June	271 (8)
July	349 (11)
August	399 (12)
September	532 (16)
October	534 (16)
November	521 (16)
December	2 (<1)

Table 1: Description of Resident Types at Chinese Residency Programs.

Resident Type	Educational Background	Responsibilities	Duration & Post-Graduation
Faculty Track (单位人)	Most have a master's or doctorate degree in medicine (7-8 years post-secondary education)	Clinical duties, Research	Remain at training hospital as faculty 1-3 years
Masters Track (四证合一)	5 year combined undergraduate/medical school	Clinical duties, Master's degree requirements	Apply for jobs across the country (tend to enter more prestigious institutions) 3 years
Standard Track (行业人)	5 year combined undergraduate/medical school	Clinical duties	Apply for jobs across the country (tend to enter less prestigious institutions) 3 years



Performance Domains: P=Professionalism, PC=Patient Care, CC=Communication and Collaboration, S=Scholarship, SE=Systems Engagement. Asterisk indicates p<0.05.

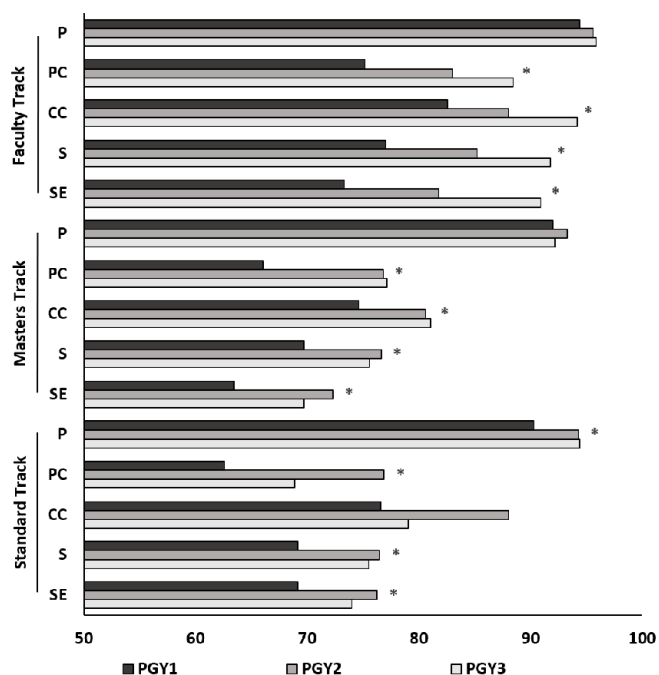
Figure 1: Proportion of Scores of Each Resident Year Reaching Graduation Standard (Score of D) on Clinical Performance Domains, by Resident Type, 03/2018 to 12/2018.

We also analyzed the proportion of residents in each resident year reaching the level expected by graduation (Figure 2). Overall scores were high, with residents in all years and domains scoring on average above the level expected of a graduating resident. 76% of PGY1 evaluations, 84% of PGY2 evaluations, and 81% of PGY3 evaluations were at or above graduation standard. In all resident types and domains, PGY1 scored the lowest, whereas PGY2 and PGY3 scored similarly across domains. Masters Track residents had significant differences between years in patient care, communication and collaboration, scholarship, and systems engagement. Faculty Track residents had significant differences between years in patient care, communication and collaboration, scholarship, and systems engagement. Standard Track residents had significant differences between years in professionalism, patient care, scholarship, and systems engagement. Taking into account the final evaluation of each graduating PGY3, 24% (86/360) competency domain scores did not meet graduation standards, with 38% (27/72) of residents receiving at least one substandard domain score. In comparison, 39% (87/221) of PGY1's and 34% (49/145) of PGY2's received at least one domain score below graduation standard.

There were no significant differences by gender in the proportion of residents reaching graduation standards in each domain, after accounting for resident type and year (Table 3).

Discussion

This paper represents one of the first in English literature to analyze Chinese resident physicians' attainment of milestones after implementation of a CBME framework for resident evaluation. Residents on average achieved milestones that exceeded graduation standards regardless of PGY class, and achieved equal outcomes regardless of gender. The results also showed discriminant validity in distinguishing novice residents from experienced residents, and Faculty Track residents from Masters and Standard Track residents. With successive resident classes, there was an increase in average scores in each domain from PGY1 to PGY2, and with variable outcomes in PGY3. Of note, 24% (86/360) of PGY3 competency domain scores did not meet the competency standard expected upon graduation, with 38% (86/360) of PGY3 residents receiving at least one substandard domain score.



Performance Domains: P=Professionalism, PC=Patient Care, CC=Communication and Collaboration, S=Scholarship, SE=Systems Engagement. Asterisk indicates p<0.05.

Figure 2: Proportion of Scores of Each Resident Type Reaching Graduation Standard (Score of D) on Clinical Performance Domains by Resident Year, 03/2018 to 12/2018.

Table 3: Proportion of Scores Reaching Graduation Standard on Clinical Performance Domains by Gender.

Domain	Male	Female	P-Value
Professionalism	1119/1210 (93%)	1933/2065 (94%)	0.10
Patient Care	917/1210 (76%)	1510/2065 (73%)	0.10
Communication and Collaboration	985/1210 (81%)	1658/2065 (80%)	0.56
Scholarship	936/1210 (77%)	1552/2065 (75%)	0.21
Systems Engagement	899/1210 (74%)	1485/2065 (71%)	0.22

Our results showed that Faculty Track residents achieved the highest performance across all domains and years. Most of these residents have finished Ph.D.'s before entering residency training, either pursuing a doctorate degree after their 5-year medical bachelor program, or directly entering a combined 8-year medical doctorate program to begin with. There is significant prestige associated with the attainment of a doctorate degree in China, often leading to greater career progression and income [11,12]. Although Masters Track residents generally have scored higher on standardized tests than their Standard Track resident counterparts, the difference between their clinical performance skills was negligible. This may be due to the two groups' identical levels of prior training (5 year medical bachelor program). For hospitals across the country that include these three resident types within the same programs, dedicated resources may be needed to address these imbalances for Masters and Standard Track residents. One such potential intervention that has been adopted in US residency programs is in the assignment of faculty advisors with whom the resident meets for performance evaluation reviews and possible remedial action for lower competencies [25].

In addition, these results show an interesting intersection with studies showing a high rate of burnout amongst residents in standardized residency training. In particular, residents in Standard and Masters Tracks have reported higher incidence of burnout, possibly due to their shorter pre-residency education and lower resilience, or lower levels of relatedness and involvement in the practice community compared

to their Faculty track counterparts [26-28]. Proposed solutions to this problem include individual level strategies as well as training on topics such as resilience and provider-patient communication. Our results show that a competency-based framework such as the one in the study has potential in identifying residents who may be at higher risk of burnout and turnover. Exploring the validity of this tool in regards to burnout is a promising direction for future research, in addition to whether this framework can serve as a tool to provide support to residents on a more individual level.

The competency assessment results also discriminated between residents of different PGY levels. There was an increase in proportion of residents reaching graduation standard from PGY1 to PGY2, as expected for the growth of residents throughout the course of their residency. Although this proportion increased from PGY2 to PGY3 with Faculty Track residents, it did not occur between PGY2 and PGY3 for Masters and Standard Track residents. Additionally, a significant proportion of PGY3 residents (38%) received scores that did not reach graduation standard ("level of a physician ready to practice independently"). More research is needed to determine whether factors such as interviews during the PGY3 year or a lack of faculty familiarity with the CBME evaluation process contributed to this finding.

The finding that a substantial portion of PGY3 residents received scores that did not reach graduation standards indicates that this evaluation tool identifies training needs that were missed by existing evaluation systems. The graduation standards are based on consensus of faculty on competencies required of a physician ready to practice independently, and these data suggest that one in three PGY3 residents need further improvement to achieve competency milestones by graduation. In contrast, only 1 of 95 residents in this PGY3 class failed their national residency graduation exam. This shows that the competency framework provides a more rigorous evaluation system that is more effective in identifying learners who are behind with important competency milestones and may benefit from targeted support.

On the other hand, a substantial portion of PGY1 and PGY2 residents (61% and 66%, respectively) attained graduation standards across all domains. However, this information is not yet robust enough to make summative judgments, and more data is needed on the validity of these milestone assessments and whether they accurately determine when residents are able to graduate into independent practice. Supporting data from a variety of assessment sources in addition to these monthly assessments would help in making these judgments.

Regarding gender, our data show that 63% of evaluations were filled out for female residents. This proportion was consistent across relevant categories, with 60-65% of resident evaluations being for female residents in all years and resident types. This is similar to other studies in recent years which have shown a greater proportion of female than male medical trainees [29]. Our data showing that there was no significant difference in evaluation performance in any of the five domains studied across gender suggests that the higher proportion of female resident evaluations did not affect the results.

Looking forward, there are multiple directions in which Chinese CBME frameworks such as this one can be refined in order to build on current realities and strengths of residency training in China. The frameworks will require revision based on feedback from stakeholders including program directors and faculty assessors regarding the relevance and wording of each competency. Another, given that currently every specialty has the same milestones, is expanding the framework to include primary care and specialty care (e.g. cardiology, geriatrics, etc.), which will help to define competencies in various practice environments.

There are limitations to consider in this study. This is a single institution study, and these data only represent the performance of each resident during a single year. Additionally, due to high mean scores,

our analyses are based on graduation standards rather than year-specific expectations. The high mean scores could be a result of the time needed for faculty to adjust to a new evaluation system, and training about its proper use may help to achieve results that are more in line with the standard grades for each year. Finally, these data represent a snapshot of performance trends under this new evaluation system and did not evaluate trends of individual residents over time. Future work should include studying longitudinal competency data to see if these trends hold over time.

Conclusion

In conclusion, this analysis of Chinese resident performance using a locally-developed competency framework showed that competency attainment differed amongst resident types with varying education backgrounds, particularly between Faculty Track residents and other resident types. Residency training programs can use competency-based evaluation systems to identify and support residents who may need further assistance to reach all milestones by graduation, and develop more resources for individualized mentoring of resident physicians. Overall, this research provides examples of how a CBME framework can guide residency programs as they strive to ensure quality training for each of their residents, adding to previous calls to adopt CBME and establish competency-based training frameworks in residency programs.

Ethics Approval and Consent to Participate

The study protocol was approved by the University of Chicago Institutional Review Board. All methods were performed in accordance with relevant guidelines and regulations. Administrative permission to use the raw data was granted from the Zhongnan Hospital Office of Education. There was no need for obtaining informed consent for this study, since it was retrospective use of anonymous evaluation data collected as part of normal training program operations.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

SH performed data analysis and was the primary writer of the manuscript. YY directed the development and implementation of the CBME system at Zhongnan Hospital. JL also developed the CBME system and directed the analysis of data. ZC also directed the development and implementation of the CBME system at Zhongnan Hospital. RS oversaw the analysis and collaboration between the University of Chicago and Zhongnan Hospital.

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Appendix 1: Core Competencies Analyzed.

Professionalism	Possessing the core values of a physician
Patient Care	Possessing the knowledge to manage disease
	Mastering knowledge of examination and diagnosis
	Formulating plans for treatment
	Procedural skills
Communication and Collaboration	Writing patient notes
	Patient-provider communication skills
	Medical team communication skills
Scholarship	Continual learning
	Feedback and improvement
	Teaching
Systems Engagement	Providing discharged patients with social resources

Appendix 2: Excerpt of Resident Competency Assessment Scale (Patient Care Domain).

Patient Care Competencies	Grade				
	A	B	C	D	E
Possessing the knowledge to manage disease	Lacks ability to describe routine symptoms, diagnoses, and treatment steps	Able to describe routine symptoms and diagnoses, but insufficient ability to provide treatment	Able to thoroughly describe routine symptoms and diagnoses, proactively prepares for special cases	Possess knowledge to handle complicated diseases using knowledge of relevant scientific, socioeconomic, and behavioral factors.	Able to correctly diagnose and treat complicated diseases using knowledge of relevant scientific, socioeconomic, and behavioral factors.
Mastering knowledge of examination and diagnosis	Does not completely understand how to use basic components of history and physical exam	Understands how to use basic components of history and physical exam	Understands and can apply basic components of history and physical exam	Accurately understands how to use advanced components of the history and physical exam, and the significance of the results	Understands limitations of components of the history and physical exam
Formulating plans for treatment	Unable to formulate appropriate treatment plans	Able to formulate preliminary treatment plans for routine cases	Able to formulate treatment plans according to individual cases	Able to formulate and execute treatment plans according to individual cases, and cooperates with patient and family members	Able to formulate complicated treatment plans centered around the patient's interests, and able to instruct team regarding plans
Procedural skills	Does not know indications and contraindications for routine specialty-specific bedside procedures for diagnosis and/or treatment	Familiar with indications and contraindications for routine specialty-specific bedside procedures for diagnosis and/or treatment	Able to order and complete routine, appropriate bedside procedures based on individual cases	Able to order and skillfully complete all appropriate bedside procedures based on individual cases	Chooses ideal bedside procedures for diagnosis, evaluation, and/or treatment; taking into account severity of patient's condition and the risk for worsening, and safely carries out procedure with proper adjustments