



Lessons learned from a novel 3-year longitudinal stepwise “Residents-as-Teachers” program

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Abstract

Background: Most residents-as-teachers (RaT) programs are delivered over days to weeks without comprehensive evaluation, and stepwise approaches have rarely been applied to RaT activities. This study aimed to depict the implementation experience and evaluate the effectiveness of a novel longitudinal 3-year, stepwise RaT program.

Methods: The longitudinal RaT program included three once yearly face-to-face courses according to the different teaching roles of the residents. To evaluate the effectiveness of the new longitudinal program, we designed a randomized controlled study for first-year residents of all specialties in one medical center. The effectiveness was evaluated by the objective structured teaching exercise (OSTE), feedback from participants and medical students, and evaluation of clinical practice performance by program directors.

Results: A total of 35 (37.6%) of 93 residents participated in this study, and 13 (37.1%) of all enrolled residents completed all 3-year courses, including seven for the longitudinal program and six for the traditional. The serial OSTE revealed significantly higher scores in the longitudinal group in the second and third years (13.43 vs 9.50, $p = 0.001$ and 14.29 vs 10.33, $p = 0.015$). Satisfaction was higher when advanced topics were taught in the second and third years compared with those taught in the first year (4.43 vs 3.89, $p = 0.02$). The feedback from medical students was similar between the two groups, and the evaluation from program directors revealed insignificantly better clinical performance among the longitudinal course participants.

Conclusion: It is challenging to conduct a multi-year longitudinal RaT program on young residents. Nevertheless, this longitudinal program was potentially associated with better learning retention and higher satisfaction and worthy to be promoted.

Keywords: Effectiveness; Longitudinal; OSTE; Randomized-controlled; Residents as teachers

1. INTRODUCTION

Clinical teachers in teaching hospitals should develop the core knowledge, skills, and attitudes to teach, evaluate, guide, and remediate individuals or small/large groups. Residents are the predecessors of the attending physicians and play an important teaching role in medical care teams composed of attending physicians, residents, and students, because residents have a long contact time with students and are their role models for learning professionalism.^{1–3} In some clinical circumstances, they are probably more suitable than attending physicians to pass on the required knowledge and skills in a timely manner to students. Furthermore, teaching also has a positive impact on the clinical training of residents themselves.^{4–6} Residents play

such an important role as peer teachers and trainee teachers and spend considerable working hours in clinical teaching.^{7–11} Effective teaching skills are critical not only for the learning quality of medical students and junior colleagues but also for saving their valuable working hours. As a result, “residents-as-teachers” (RaT) programs have gradually emerged since 1970 and increasing reports have depicted the design, experience, and effectiveness of RaT programs in various contexts.^{6,8,12–32} In an evaluation report in 2017, over 80% of program directors (PDs) were found to implement RaT, an increase of 26.34% compared to 2000–2001.³³ These RaT programs were highly variable, from coaching one specific teaching skill in a specialty to a series of courses covering common teaching skills.

Nevertheless, almost all of these previously reported RaT programs were designed to be completed within a short duration, usually from one day to several months, and without effective objective evaluation and long-term follow-up. Besides, only a few studies were randomized controlled trials, and most were conducted between 1998 and 2006.^{12–19} Without comprehensive effectiveness evaluation, it is difficult to confirm whether the residents receive sufficient training to become effective teachers. The Kirkpatrick model is a systemic approach suggested for evaluating the effectiveness of teaching programs.³⁴ However, some reports have only described the experience or satisfaction data of RaT. To evaluate the higher-level effectiveness, variable evaluation tools, such as clinical teaching effectiveness

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Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

Journal of Chinese Medical Association. (2023) 86: 577-583.

Received April 18, 2022; accepted October 3, 2022.

doi: 10.1097/JCMA.0000000000000928.

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instruments, student questionnaires, and observed structured teaching evaluations (OSTE), have been applied.^{23,25,35} OSTE is considered the most objective and reliable tool, although it is quite resource-intensive.^{19,36,37}

On the other hand, competency-based medical education has been mainstream since the 2010s. The international community has gradually formed a consensus to develop several theoretical frameworks for faculty development and designed core teaching competencies as a reference and guide for designing, implementing, and evaluating competency-based faculty development programs for medical educators or clinical teachers.^{38–40} However, there has been a lack of consensus and few reports on the core teaching competencies and milestones for residents and competency-correlated RaT programs.⁴¹ Learning theories such as humanistic theory, constructivism, and andragogy suggest that the learning courses should match the needs of learners' context, and learning occurs better when the given lessons are in line with the real environment. We observed that senior residents need different teaching skills during their training process and coaching all teaching skills early in the residency is not effective in terms of learning theories. In addition, an important review on RaT courses recommends that, if possible, such courses should include periodic reinforcement activities.²⁰ Based on the concept of competency-based curriculum and the recommendations from the literature, we designed a longitudinal, 3-year, stepwise RaT program and launched this program in fall 2016. A randomized controlled study design and multiple evaluation tools were applied to investigate the effectiveness of this new program in comparison to the traditional RaT program. In addition, we would also report the lessons learned from the implementing such a multi-year longitudinal program.

2. METHODS

2.1. Conceptual framework

The research team developed a conceptual framework (Fig. 1) for presenting the main concepts of development of an innovative RaT program which improve deficits of most current RaT programs.

2.2. Longitudinal curriculum design

The institution of this study, Taipei Veterans General Hospital (VGHTPE), is one of the leading public medical center in Taiwan. The Faculty Development Center has provided elective RaT courses since 2012. The initial courses were designed based on some reported RaT courses, such as the RaT courses of the University of British Columbia, Canada,⁴² UC BEST model, USA,¹⁷ and the needs assessment of the local residents. These RaT courses were usually delivered in a workshop lasting 6 to 8 hours. Although there were several guidelines and recommendations, such as the Dundee 3-circle model and the Program Logic Model, for RaT program design published in the past few years,^{11,25,43} these resources were not available at the time of developing this stepwise longitudinal program in early 2016.

Based on the framework of the six-step approach of curriculum development by Thomas et al.,⁴⁴ the new RaT courses were developed by a curriculum development team consisting of nine members, including three clinical educators from the Faculty Development Center, three PDs, and three junior residents. At the time of program development, there was no consensus on the general teaching competency of residents reported in the literature. After two consensus meetings, the course development team identified teaching-related activities according to the teaching roles of residents in different stages. Correlative teaching skill topics were then proposed. A total of eight topics covering the roles of teachers of residents were included in the RaT program (Table 1). Among the courses, “how to perform case-based discussion assessment” was taught in the second year and “the skills for group teaching” was delivered in the third year for the new course residents. Other topics were taught during the first year. This stepwise program design fulfilled Knowles' concepts of andragogy,⁴⁵ which claimed that adult learners find the most relevance from task-oriented learning that aligns with their own realities. In addition, two reinforcement sessions for 1-minute preceptor skill and teaching experience sharing sessions were arranged in the second and third year, respectively, because periodic reinforcement is a widely applied educational psychological strategy to overcome the “forgetting curve” and suggested by a previous RaT review.²⁰

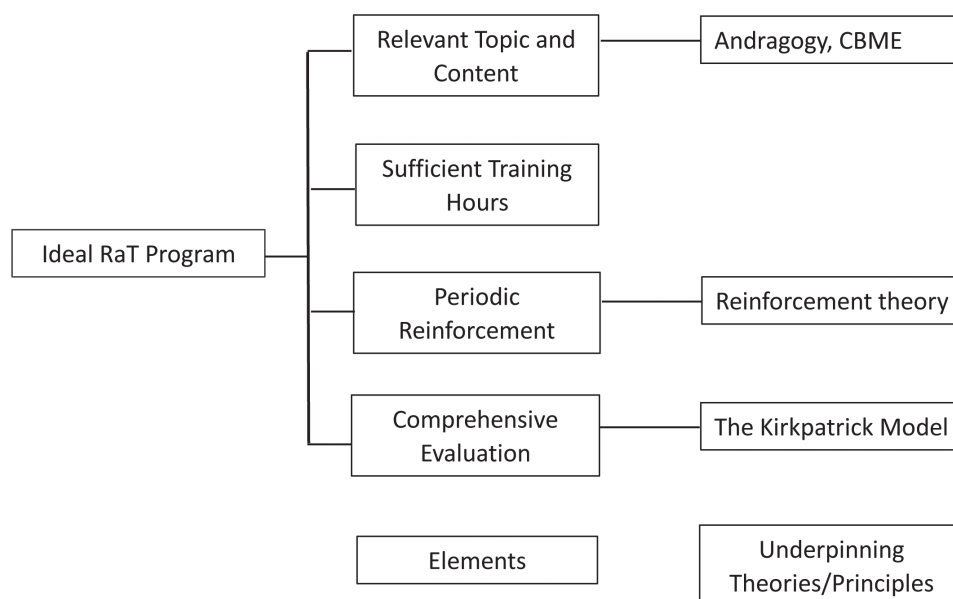


Fig. 1 The conceptual framework of the novel RaT course design. CBME = competency-based medical education; RaT = Residents as Teachers.

Table 1
Stepwise courses of 3-year longitudinal RaT program

First-year courses	Second-year courses	Third-year courses
Introduction of Residents as Teachers	How to do Case-based Discussion (CbD) Assessment	Facilitate group teaching
Guidance of clinical reasoning and decision-making	OMP Reinforcement (Workshop)	OMP Reinforcement (Workshop)
How to make your slides and presentations excellent	Teach experience sharing	Teach experience sharing
Tips of Efficient Clinical/Beside Teaching		
Teaching of Clinical Skill and Feedback		
Workshop: one-minute preceptor		

2.3. Participants

In Taiwan, all medical school graduates have to receive two-year postgraduate training before they enter their residency for specialty training. Every year, approximately 90 to 95 first-year residents (R1) start their specialty training in VGHTPE. All R1 who started their specialty training in 2016 in VGHTPE were invited to participate in this study.

2.4. Intervention

The R1 who agreed to participate the program effectiveness study were randomly assigned into two groups: the new course (longitudinal) group and the traditional group. The total number of course hours between the two groups was controlled. After leveraging the clinical duties, preference of the residents, and the learning resources, the first-year RaT courses for both groups were held in the form of a 1-day face-to-face workshop with two batches. In the former group, the different courses were given separately according to predefined teaching competency within the duration of 3 years. Meanwhile, in the latter group, the same teaching courses as the new course group were all delivered in a 1-day training in the third month of the first year. The participants of the traditional group were asked to complete 3 hours of learning of any teaching skills-related courses in the second and third year, respectively. The study design is illustrated in Fig. 2. This study was approved by the institutional review board of VGHTPE.

2.5. Outcome measures

The effectiveness of the RaT courses was evaluated using multiple evaluation tools that covered different levels of

Kirkpatrick’s hierarchy. The serial objective structured teaching exercise (OSTE, Kirkpatrick’s level 2) scores were the primary outcome variables. Other outcome variables included qualitative feedback of the course design and experience from the participants (Kirkpatrick’s level 1), the teaching performance feedback from medical students (Kirkpatrick’s level 3), and evaluation of clinical competency from program directors (PDs, Kirkpatrick’s level 4b). The evaluation methods are further described below.

As a well-developed, objective evaluation tool, OSTE has been suggested for confirming the effectiveness of faculty development interventions. The OSTE in our study was a one-station test for teaching skill evaluation. The scenario of the OSTE in the first and second year was “teaching an intern after they interviewed a patient with left shoulder pain,” which was adopted in previous teaching skills training of VGHTPE. The scenario in the third year was “teaching an intern after they treated a patient with consciousness change.” The length of this station was 8 minutes of practice and 2 minutes of immediate feedback (no feedback given in the pretest). The same eight items were checked in these two scenarios, and the full score was 16. The skills of OMP, including feedback, teaching concisely, diagnosing the learner, and bedside teaching are included. Each resident was evaluated by two raters. All raters were experienced in OSTE and received a one-hour consensus training before their first rating for this station. Cronbach’s alpha values for the two scenarios were 0.84 and 0.81, respectively.

Satisfaction was evaluated using a 5-point Likert scale with qualitative feedback from the participating residents and

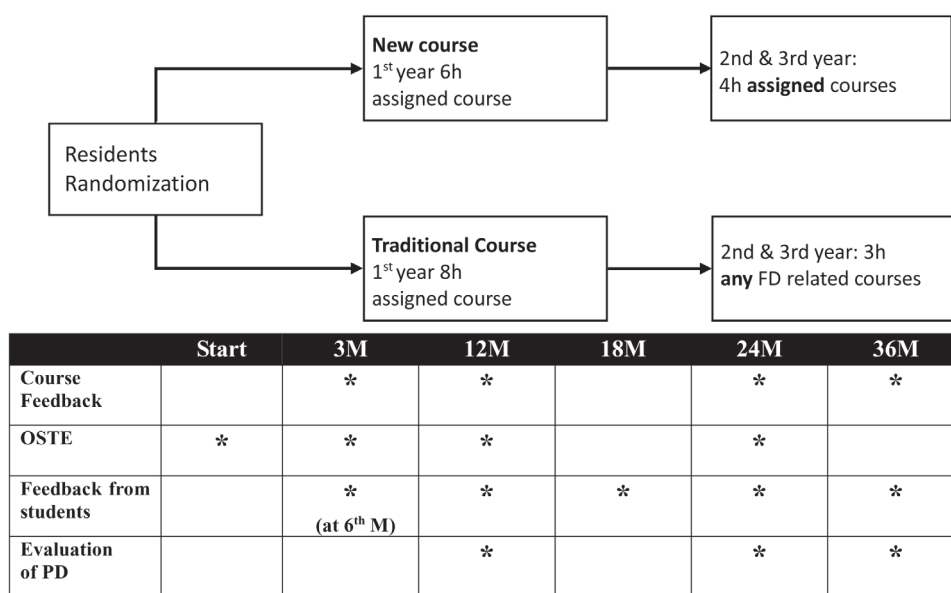


Fig. 2 Study design of effectiveness of longitudinal residents-as-teachers courses. FD = faculty development; OSTE = objective structured teaching exercise; PD = program director.

collected via a paper-based questionnaire for every teaching course. The data on teaching performance feedback from medical students were collected from the Teaching Assessment System (TAS) of VGHTPE. The system was launched in 2012, and all medical students were asked to provide both quantitative and qualitative feedback for their residents in clinical rotation upon completion of any course. The quantitative data collected were “the overall impression in teaching of your resident,” which was evaluated using a 5-point Likert scale. Up to the end of 2021, more than 30 000 data samples were collected and the data were utilized for consideration of the teaching award, teaching team list, and promotion. The mean TAS scores every 6 months were calculated to evaluate the immediate and remote effects of RaT courses, since the courses were given once at the start of each year.

The PDs were asked to evaluate the overall clinical performance of all residents at the end of each training year. The clinical competency evaluation form was modified from the concept of Larkin et al.⁴⁶ A four-level scale (3 = exceptional, 2 = expected, 1 = below expectation, 0 = extremely poor) was used to evaluate residents' clinical performance.

2.6. Data analysis

Chi-square analysis was used to examine the demographic features of the two groups. An independent t-test was applied to determine the course satisfaction between the two groups. For the serial OSTE scores, the Wilcoxon rank sum test with exact estimation was performed to determine if there was any discrepancy between the two groups due to the relatively small number of participants. The generalized estimating equations approach was utilized to examine the significance of the change in OSTE scores over time. Analysis of variance (ANOVA) was applied to analyze feedback from students and evaluation from PDs. All analyses were performed using SAS.

3. RESULTS

In 2016, the number of eligible R1 in all specialties was 93, and 40 (43.0%) agreed to participate in this project; however, five dropped out before the initiation of the course. A total of 35 residents were randomly assigned to the two groups. Demographic data of the two groups are presented in Table 2. A total of 24 R1 completed the first-year courses and 13 residents, including seven of the new course group and six of the traditional course, finished all assigned course activities.

The satisfaction of the different courses from the participants ranged from 3.80 to 4.71. The most popular topic among this first year was “How to make your slides and presentations excellent.” Of note, satisfaction was higher (4.43 vs 3.89, $p = 0.02$) when the same topics were taught in the second year (how to perform case-based discussion evaluation) and the third year (facilitate group teaching). Some notable qualitative feedback included: “I enjoyed the sharing from different specialty residents,” “I never learned teaching skills and now I understand my weakness on teaching and will improve it,” and “hope the course content could be tailored for different background, for example, teaching in the operation room.”

The serial OSTE results are illustrated in Fig. 3. Both groups demonstrated an increase in scores after the first-year course. In the new course group, the scores increased in the following years, whereas they decreased in the second year in the traditional group. The OSTE scores between the two groups differed significantly in the second and third years.

The feedback from the students about the roles as a teacher of the resident from the TAS system demonstrated no significant difference between the two groups during the whole program period on average 6-month scores (range from 4.57 to 4.74/5, detailed data available on request). The evaluation of clinical competency for the residents by PDs on the end of each year showed better performance among the residents who had received RaT courses but with a marginal statistical significance (Table 3).

4. DISCUSSION

This study was originally planned to demonstrate comparative effectiveness between a 3-year longitudinal, stepwise, and traditional RaT courses by a randomized controlled design with multiple levels of effectiveness evaluation. However, both the participation and completion rate of our RaT courses were around 40%, which was below our expectations and weakened the reliability of the effectiveness evaluation. Based on the available data, the OSTE scores, demonstrated a significantly better performance in teaching skills in the new course group, whereas no difference was noted in the feedback of students and course satisfaction between the two groups. The evaluation from PDs revealed insignificantly better clinical performance among the longitudinal course participants.

The low participation and completion rate for our RaT courses reflected the challenges faced by longitudinal program

Table 2
Demographic data of the participating residents

		New course (n = 18)	Traditional course (n = 17)	<i>p</i>
Gender				
Male	Participated	15 (5)	11 (5)	0.09
	(Completed)			
Female	Participated	3 (2)	6 (1)	
	(Completed)			
Specialty				
Internal medicine-oriented specialties ^a	Participated	13 (4)	12 (5)	0.63*
	(Completed)			
Surgical-oriented specialties ^b	Participated	4 (2)	3 (1)	*for participated only
	(Completed)			
Other specialties	Participated	1 (1)	2 (0)	
	(Completed)			
Course Completion	N(percentage)	7 (38.9%)	6 (35.3%)	0.68

^a Internal medicine, neurology, psychiatry, pediatric, family medicine, physical medicine and rehabilitation, and dermatology.

^b Surgery, obstetrics/gynecology, orthopedics, urology, anesthesiology, emergency medicine, ophthalmology, and otolaryngology.

^c Nuclear medicine, diagnostic radiology, pathology, and radiation oncology.

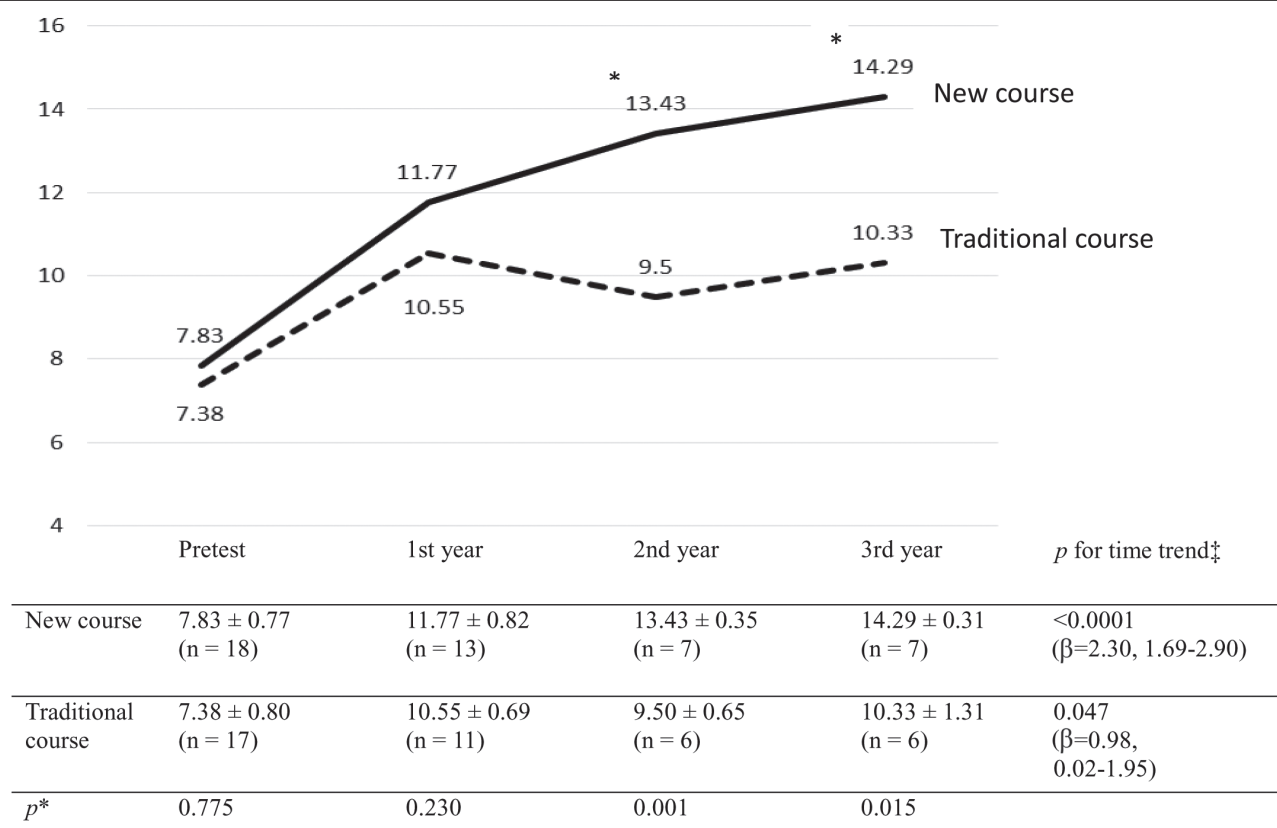


Fig. 3 The serial one-station OSTE scores among the residents of different groups. Values are presented as Mean ± SE. **p* value is derived from Wilcoxon rank sum test with exact estimation. ‡*p* value is derived from the Generalized Estimating Equations approach.

Table 3
The evaluation of clinical competency among residents from program directors

	Evaluation timeline		
	End of R1	End of R2	End of R3
New course	2.62 (n = 13)	2.86 (n = 7)	2.86 (n = 7)
Traditional course	2.33 (n = 9)	2.50 (n = 6)	2.50 (n = 6)
Dropout residents (who did not attend or complete courses)	2.13 (n = 16)	2.42 (n = 24)	2.38 (n = 24)
<i>p</i>	0.109	0.188	0.083

The clinical competency was evaluated with a four-level scale (3: exceptional, 2: expected, 1: below expectation, 0: extremely poor). *p* value is derived from ANOVA. R1 = first-year residents; R2 = second-year residents; R3 = third-year residents.

organizers. Another large-scale RaT randomized controlled study for a shorter duration (6 months) training session showed about 50% (62/121) participation rate for all R2 residents with an adherence rate of approximately 90% (56/62).¹⁷ The proportion of participating this program among all residents of internal medicine-oriented specialties, surgical specialties, and other specialties are 61.3%, 29.0%, and 22.2%, respectively. The result showed residents from surgical departments and the specialties without inpatient-care service had difficulty or lower motivation in participating this program. To further explore the reasons for the low participation rate, we conducted a questionnaire survey on the reasons for nonparticipation or absence from the scheduled course. The most reported reasons of nonparticipation are “heavy clinical load” (82.4%) followed by “don’t want to waste a weekend to participate in such activity” (29.4%), limited time choice (23.5%) and “no great need in teaching skill training”

(17.6%). The common reasons for absence from the scheduled course included “some unexpected clinical event” (38.4%), “scheduling conflict” (30.8%), and “exhaustion due to prior night shift” (30.8%). In addition, a few residents mentioned that the course design could not meet the needs of some specialties without inpatient services, such as pathology and radiology. A total of 68% of the nonparticipants would consider participating in the courses if online-based training course were available as an alternative, whereas 32.4% suggested that the course should be held on weekdays. Compared with short-duration programs, the longitudinal program needs more flexible options for busy trainee teachers to increase adherence.

Even fewer than the expected number of residents completed the courses; the significantly higher OSTE scores suggested the advantage of the longitudinal and stepwise course design. Our longitudinal courses included an experience sharing and one-minute preceptor review session in the last 2 years. Through periodic reinforcement, the evaluated teaching skills among residents of the longitudinal group continued to improve throughout the three-year course duration. On the other hand, the traditional course group showed transient improvement in teaching skills after the teaching workshop in the first year. However, the OSTE scores declined in the second year and slightly increased again, possibly due to the maturation effect in the third year. Our findings provide solid evidence for the effect of periodic reinforcement in RaT programs. The course satisfaction data also indicated the advantage of stepwise curriculum design over extensive courses given within a short duration, because residents at different stages need different teaching skills. This illustrates the concepts of andragogy and constructivism. The unnecessary teaching skills taught too early are not valued by the trainees, for example, facilitating the teaching in group. In

addition, the learned skills decay over time if the residents do not apply them frequently in clinical teaching settings.

Learning theories and experience in the real world suggest that teaching itself facilitates learning, and resident-as-teachers are more than just about student learning.^{4,47} However, the benefits of such trainee teachers' teaching or teaching skill training have rarely been reported in the literature, especially in the clinical setting.⁵ One study concluded that themes linking clinical and teaching skills are similar for both patient-physician and learner-teacher relationships and improving residents' teaching skills may not only benefit the education of learners but also improve the care of patients.⁶ We tried to provide evidence about the positive impact of RaT on residents themselves, and hypothesized that residents who received effective RaT courses would have better performance in clinical service. Although the results of evaluation by PDs lacked statistical discrepancy, probably due to the small case numbers, the data showed a trend that residents completing teaching skills training had better clinical presentation. Furthermore, the residents who kept enrolling in any RaT program had better clinical performance than those dropped-out of the program. The result implicated that participating RaT course is better, regardless the course design. These benefits for residents should be further explored in the future.

Our experience showed that the routine feedback of students to their residents was usually highly positive and failed to demonstrate the differences in teaching quality among two groups. Feedback from students is an important indicator of the effectiveness of RaT courses and some student evaluation of teaching (SET) tools have been developed for evaluating clinical teaching.^{35,48,49} However, we did not plan to adopt these tools because these tools are often more complicated and time-consuming. A more structured SET tool should be considered in future studies.

The strengths of this study include a novel stepwise longitudinal course and randomized controlled study design. We included several levels of effectiveness evaluation, including the objective evaluation method (OSTE) and new evaluation model (clinical competency), to explore the impact after RaT training. However, this study has some limitations. First, the small number of participants which were most male and from internal-medicine-oriented specialties made it difficult to draw convincing result statistically. However, we believe the experience of conducting such a novel multi-year program is still worthy to be shared. Second, there were no widely used teaching competency milestones for residents, and the necessary teaching skills likely varied among residents of different specialties. We included members from different specialties to design the longitudinal course, and the teaching skills included in our courses were the most general principles of teaching. In addition, we only adapted the one-station OSTE, which mainly focused on bedside teaching and feedback skills. Holding a multiple-station OSTE for many residents is challenging. We believe the scenario we chose is representative of main teaching activity and the one-station OSTE was sufficient to demonstrate the value of periodic reinforcement. Finally, the experience were based on one cohort, that is, the R1s in 2016. This longitudinal course was still continued in the following years, and some online courses were supplemented according to the feedback of residents in our institution. The positive effects of longitudinal RaT were still observable. We will report the experience and effectiveness after repeating a stable online hybrid longitudinal program with more participants.

In conclusion, it is challenging to conduct a multiple-year longitudinal RaT program for young residents. However, this innovative longitudinal program demonstrates the potential on increase learning retention and the importance of periodic reinforcement. The stepwise course design also satisfies the learning needs of residents at different levels. Further efforts, such as

learning time protection, providing flexible online courses, and more customized courses are needed to increase the participation in and adherence to RaT.

ACKNOWLEDGMENTS

This study was supported in part by grants from the Ministry of Science and Technology, Taiwan (MOST 105-2511-S-010 -003 -MY2 and 107-2511-H-010 -006) and Taipei Veterans General Hospital (V111EA-006).

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