Background and Objectives: To explore the superiority of flipping-classroom lended learning in which the stay-home e-learning and traditional internship complements each other in resident training of endocrinology during coronavirus disease 2019 restriction period. Materials and Methods: A total of 44 residents were randomized as the study population. In the endocrine-rotation training, we reformed the clinical learning by unified online-teaching led by teachers’ combination with individual guidance by residents. Moreover, the final implementation assessment was conducted by standard double-blind examinations. Results: After 4–8 weeks training, the 44 residents were assessed for clinical skills from six dimensions, including medical history collection, physical examination, history report and inpatient record writing, case analysis, and overviewing capability. Compared with the mean scores of 68 residents rotated in internal medicine in 2019, the mean scores on physical examination, inpatient record writing, and overviewing capability in 2020 group were higher with significance ([85.72 ± 8.33] vs [79.22 ± 10.12], P = 0.0006), ([90.28 ± 10.70] vs. [81.82 ± 8.03], P < 0.0001), ([80.31 ± 8.70] vs. [73.04 ± 12.74], P = 0.0012), whereas scores on skills of medical history collection and history report were slightly lower ([82.11 ± 9.02] vs. [85.06 ± 7.23], P = 0.0586), ([79.30 ± 8.17] vs. [83.21 ± 5.01], P = 0.0022), while scores on case analysis did not show huge gap but with polarized performance in 2020 group ([74.38 ± 10.29] vs. [78.13 ± 8.53], P = 0.0386). Conclusions: Providing the novel pattern of unified online-teaching combined with individual-guidance at the bedside to the front-line residents can reduce the risk of cluster epidemics and effectively ensure the training effect on them but still with shortcomings. The future online teaching reform is better for focus more on how to make up for or reduce the actual problem of disconnection between theory and practice in the process of online clinical skills training for residents and teachers.

Keywords: Coronavirus disease 2019, individualized guidance, online teaching, standardized resident training

Exploration and Thinking in Mixed Flipping-Classroom Teaching Approach on Clinical Endocrinology during the Coronavirus Disease 2019 Period

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Thus, under the guidance and coordination of the internal medicine faculty, Changzheng hospital, the department of endocrinology made full use of the existing network teaching platform and digital resource library, through the implementation of the network teaching platform to play teaching videos, operation demonstration videos, and organized online based on Problems Learning (PBL) teaching, interactive Q and A and discussion between teachers and students on the internet teaching platform, theory online test and other internet-based hybrid teaching model, successfully completed the tasks of standardized training courses of endocrinology for residents, and achieved good results. The research content is now reported as follows.

MATERIALS AND METHODS

Subjective

Forty-four residents rotated in endocrinology from February 2020 to July 2020 were enrolled in this study. Participants who had the following criteria were excluded from the study: undergraduates, postgraduates, advanced doctors, and students who asked for leave for personal affairs. In addition, 68 individuals rotated in endocrinology during the same period in 2019 were selected as controls.

Establishment of endocrine resource libraries

In the previous reforming researches, our internal medicine faculty have paid great attention on the construction of online teaching. The excellent video resource libraries now boost clinical basic courses (i.e. symptomology, physical examination and demonstrations, medical history collection and cases writing, diagnosis, and typical cases study), and internal tertiary education (i.e. cardiology, respirology, gastroenterology, nephrology, endocrinology, rheumatology, immunology, and hematology). All the above lessons and clinical skills operation meet the needs for e-learning resources through multimedia, video, and decomposition demonstrations. These preestablished resource libraries laid a solid foundation for the smooth implementation of network teaching platform during the restriction.

Assessment and statistical analysis

Before the end of each trainee's rotation in endocrinology, they need to enter the “Online Test” on the network platform to complete the related theoretical tests. Meanwhile, all trainees in the hospital are required to complete the skill operation assessment, including medical history collection, physical examination, history report, inpatient record writing, case analysis, and presentation on research progress. The scoring standards refer to the evaluation standards for standardized training of residents in Shanghai, China. All the scores of every resident were summarized and performed statistical analysis with SPSS 19.0 statistical software (IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp). In the present study, N (%) are for count data and mean (standard deviation) or median (Q1, Q3) are for measurement data. Data comparison between the groups was performed with t-test or Mann–Whitney U-test (according to the homogeneity of variance). $P < 0.05$ is with statistical significance.

RESULTS

A hybrid online learning model (emergency remote learning and Reversed Mixed Learning Pattern) based on an online teaching platform

Based on further enrichment and expansion of emergency remote learning (ERL), our hybrid online learning model conducted in this research integrated online multimedia and video courses, online PBL interactive learning, e-communicative platform Q and A sessions, and online tests. The specific implantation steps were as follows: First, all teachers were requested to prepare lessons collectively. Each course was recorded through lecture videos for 40–80 min, supplemented by videos and multimedia, and uploaded to ERL session. During the rotation in endocrinology, every trainee of the 2017, 2018, and 2019 standardized training program was authorized to watch videos and courses by themselves and complete homework after class.

Besides, we implanted the Reversed Mixed Learning Pattern (RMLP) with the rotated trainees. Under the lockdown, endocrinEL instructor organizes students to conduct PBL teaching in groups on the network platform, guiding students to further deepen their understanding of the course content and flexibly master its clinical applications.

At the same time as the class, the 1:1 teaching teacher and the instructor of this class will use the WeChat platform to build a discussion group, online, and real-time interaction for discussion and answering questions.

Finally, students enter the “Online Test” section of the network platform to complete test questions related to the content of the course.

Subjective and control characteristics

Residents who completed standardized training in the Endocrinology Department of the Second Affiliated Hospital of Naval Military Medical University from January to July 2020 are used as the new teaching model training group ($n = 44$), and the residents who rotate in the endocrinology department during the same period in 2019 are used as the traditional teaching model. control group ($n = 68$). There was no statistical difference between the two groups of students in gender composition, age, education level, and source of students.

Comparison of the clinical skills assessment results of the two groups of students

Include 44 standardized training residents who received 4–8 weeks of standardized training in the endocrinology
department with a mixed inversion teaching model during the 2020 annual epidemic. These 44 students were treated before leaving the department. Clinical skills are evaluated in six dimensions, including medical history collection, physical examination, history reporting, medical record writing, case analysis, and progress retrieval capabilities. Compared with the 68 trainees in the department of endocrinology who were taught by traditional clinical practice in 2019, the new teaching under the model, students score better in physical examination, medical record writing and progress retrieval ability ([85.72 ± 8.33] vs. [79.22 ± 10.12], P = 0.0006; [90.28 ± 10.70] vs. [81.82 ± 8.03], P < 0.0001; [80.31 ± 8.70] vs. [73.04 ± 12.74], P = 0.0012), with lower scores in history collection and report ([82.11 ± 6.02] vs. [85.06 ± 7.23], P = 0.0266; [79.30 ± 8.17] vs. [83.21 ± 5.01], P = 0.0022) [Figure 1 and Table 1].

Comparison of the case analysis skill assessment results of the two groups of students

Compared with the 68 trainees in the department of endocrinology who were taught by traditional clinical practice in 2019, the new teaching under the model, students score better in case analysis did not show visible gaps ([74.38 ± 13.29] vs. [78.13 ± 8.53], P = 0.0714), but the trainees who received the new teaching model had a higher coefficient of variation in the score of the case analysis (14.90% vs. 10.91%), there is polarization [Figure 2].

**DISCUSSION**

Since the period of prevention and control of novel coronavirus pneumonia corona virus disease 2019, medical institutions are faced with how to carry out standardized training for residents effectively and safely. Based on the network teaching platform, we, the Department of Endocrinology in Changzheng Hospital, carried out internet-based plus traditional blended teaching pattern,[4] and successfully completed the standardized training mission for residents on endocrinology and metabolism. The results were relatively satisfied after preliminary attempts.

**A hybrid online learning model (ERL and Reversed Mixed Learning Pattern) based on an online teaching platform**

Network teaching platform and endocrine-related digital resource library, through the implementation of the RMLP platform to play teaching videos, operation demonstration videos, and organized online PBL teaching, interactive Q and A and discussion between teachers and students on the internet or bedside platform, theory online test, and other internet mixed hybrid teaching models. Based on internet discussion group included teachers (attending professor, attending physician and chief residents) and students (resident standardized trainees) to realize real-time interactive discussion and Q and A sessions.[5] All these network resources and optimized diversified clinical teaching mode are for guiding students further deepen understanding of course contents and master the application.[6]

**Conclusions**

The emergence of the new crown pneumonia epidemic has not only caused serious harm to the whole society, but also brought great troubles to medical education. This effect evaluation confirmed that the hybrid online teaching model based on the network teaching platform can effectively...
guarantee the safe and effective development of teaching work during the epidemic prevention and control period, and it is worthy of promotion and implementation. Medical schools should also use this epidemic as an opportunity to vigorously promote the construction of online teaching platforms and teaching emergency mechanisms to deal with public health emergencies and natural disasters that may recur.

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Conflicts of interest
There are no conflicts of interest.

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