NEW EDUCATIONAL METHOD

Impact of using infographics as a novel Just-in-Time-Teaching (JiTT) tool to develop Residents as Teachers [version 2]

David Orner¹,⁴, Alice Fornari²,⁵, Sarah Marks³,⁶, Timothy Kreider³,⁶

¹Department of Radiation Medicine
²Department of Radiation Medicine
³Department of Science Education
⁴Department of Science Education
⁵Department of Psychiatry
⁶Department of Psychiatry

Abstract

This article was migrated. The article was marked as recommended.

Introduction: Resident as Teacher (RaT) curriculum continues to be recognized as a critical component of residents’ education. However, in busy clinical workplaces, there are time constraints limiting formal training for RaT. This study aimed to assess the engagement and acceptability of Just-in-Time-Teaching (JiTT) infographics, a novel RaT tool that provides digestible evidence-based knowledge & skills at the time & place where teaching happens.

Methods: The study focused on residents and faculty between July – September 2019, across 12 residency programs in six specialties. JiTT infographics were distributed weekly for six weeks. Engagement of residents was measured by open rates of infographics. Acceptability was evaluated using mixed-methods analysis of a questionnaire at the conclusion of the study, and a focus group with appointed resident and faculty champions. Descriptive statistical analyses were applied to ascertain preliminary results.

Results: Overall, 76.2% (198/260) of residents opened infographics, with an average engagement rate of 64.9% Analysis of acceptability evaluations revealed infographics to be effective and had a positive impact on teaching style.

Discussion and Conclusion: JiTT infographics function as an educational approach to support teaching strategies in the busy clinical setting. It can be adapted across diverse programs and

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Migrated Content

"Migrated Content" refers to articles submitted to and published in the publication before moving to the current platform. These articles are static and cannot be updated.

1. Elisabeth Schlegel, Donald and Barbara Zucker School of Medicine at Hofstra/Northwell
2. Alexandra Webb, Australian National University
3. Ken Masters, Sultan Qaboos University
4. Haipeng Xiao, The First Affiliated Hospital, Sun Yat-sen University
5. Anita Samuel

Any reports and responses or comments on the article can be found at the end of the article.
integrated into a teaching toolbox for residents and faculty.

**Keywords**
Just in Time Teaching, Resident as Teachers, Infographic
Introduction
Resident physicians play an instrumental role to teach clinical skills to junior residents and medical students (Bree et al., 2014; Hill et al., 2012). Several studies have found that residents spend at least 25% of their time teaching, and one-third of medical students’ clinical skills and knowledge is attributable to their guidance (Bing-You and Sproul, 1992; Seely et al., 1999; Montacute et al., 2016). To improve resident teaching skills, Canadian and United States accreditation bodies require that residents be formally trained to teach students (ACGME, 2020; Frank, Snell and Sherbino, 2015). Increasingly, specialties have adapted Resident as Teacher (RaT) initiatives into their residency programs (Al Alchkar et al., 2017; McKeon et al., 2019; Alaska et al., 2019; Ravichandran et al., 2019) by incorporating a variety of curricula and teaching methodologies (Habermehl, Habermehl and Kim, 2018; Tan et al., 2017; Watkins et al., 2017; Arya et al., 2018; Ricciotti et al., 2017). However, due to increased clinical responsibilities and time constraints, it is a challenge for programs to allocate enough time to enhance their skills (Ravichandran et al., 2019; Habermehl, Habermehl and Kim, 2018; Lacasse and Ratnapalan, 2009).

Recently, information graphics, or infographics, have become an increasingly popular format for communication in both teaching and learning due to their ability to capture attention, engage and make complex concepts and/or knowledge easily and quickly understandable (Özdamli and Ozdal, 2018; Ray Chaudhury, 2019). Well-designed infographics can be understood faster than text alone and are twice as likely to be retained (Scott et al., 2016). Many studies (Clark and Mayer, 2016; Green and Myers, 2010; Carney and Levin, 2002) reported the incorporation of visuals can enhance the learning of educational information while reducing cognitive load (Mayer and Moreno, 2003; Martin, 2014). Healthcare professionals have begun to embrace images and graphics along with mobile technology (Thoma et al., 2018) to communicate. To our knowledge, there is a dearth in published data (Thoma et al., 2018; Chin et al., 2019; Dowhos et al., 2021) on using infographics to train residents on how to teach.

With a growing demand to enhance the existing curriculum among our residents and faculty, concomitant with requirements set forth by the accreditation bodies (ACGME, 2020; Frank, Snell and Sherbino, 2015) we investigated the engagement and acceptability of Just-in-Time-Teaching (JiTT) infographics, a novel approach adaptable to diverse RaT programs that deliver evidence-based clinically relevant teaching tips. The Kirkpatrick’s (Frye and Hemmer, 2012) model of evaluation was considered to assess the engagement and acceptability of this approach. We hypothesized that JiTT infographics would promote a culture of effective teaching via self-directed learning and provide a faculty development framework for residents and faculty across specialties.

Methods
This study took place during six-week rotations from July to September 2019 across 12 residency programs in six clinical specialties (Internal Medicine (IM), Neurology, Obstetrics/Gynecology (OB/GYN), Surgery, Psychiatry, and Pediatrics). There were 260 residents and 237 faculty from five tertiary-care hospitals within a large suburban health system. Faculty inclusion was based on feedback received from a prior pilot study among residents with a goal for faculty to help reinforce engagement with JiTT content among residents.

Description of JiTT Infographics
JiTT infographics [https://libguides.hofstra.edu/mederesources/teachingresources] were implemented as a pedagogical approach to provide teaching tips when residents need them to engage with students. Infographics included both foundational clinical teaching principles (e.g., bedside teaching, learning huddle, and 5-microskills) (Supplementary File 1) and specialty-specific (e.g., how to conduct an abdominal exam, evaluate for rupture of membranes/amniotic fluid, and review neurologic imaging) (Supplementary File 2). Content for the foundational clinical teaching principles were developed by the principal investigator (AF). Specialty specific content was developed by our residents and faculty champions.

Prior to dissemination, program directors of participating residencies were recruited and asked to appoint a core faculty and resident champion to support the new initiative. The responsibilities of each champion were to provide insight regarding the logistics of delivery, identify modality for distribution based on the programs’ communication culture, and prepare specialty-specific teaching content. With the assistance of a program manager and a faculty developer project manager part of our centralized faculty development administration infographics were created using Canva Pro (Canva, Ltd, Australia), a premium graphic design platform.

Outcomes measured
Resident engagement was quantified through OpenMoves (an email marketing platform) by analyzing the rate of opened emails /total residents in each program. Subsequently, the acceptability of the study was analyzed using mixed-method analysis consisting of (1) a semi-structured focus group conducted with 36 resident and faculty champions to discuss
end-user feedback, and (2) electronic resident and faculty surveys (Supplemental File 3), which were adapted from a
previously published survey (Watkins et al., 2017); to collect data to support program evaluation at Kirkpatrick level 1
(satisfaction) and 2 (learning).

Statistical Analysis
To ensure adequate data was collected we clustered data by clinical specialty. Quantitative data were analyzed using
Prism 8 (GraphPad Software San Diego, CA). Differences between weekly engagement rates were analyzed using Chi-
Square with Yates correction. p < 0.05 was considered statistically significant.

Descriptive analyses (count, mean, standard deviation (SD), and percentage as appropriate) were used to assess
acceptability metrics and outcomes. Qualitative survey questions and narrative text from the focus group were reviewed
and coded independently using Microsoft Excel by two members of the research team (KS and DO) using conventional
content analysis (Hsieh and Shannon, 2005). This research study was deemed exempt by the Northwell Health
Institutional Review Board (IRB) as a supplementary educational tool.

Results
Engagement Results
Over the 6-week period, 198 out of 260 (76.2%) residents opened weekly emails with an average engagement rate of
65.7%. The average specialty engagement rates were highest among pediatrics (71.4%) compared with neurology
(67.8%), psychiatry (64.5%), IM (62.7%), surgery (62.2%) and OB/GYN (60.8%).

Further analysis showed that while there was an 8.5% decline in weekly average engagement rate for all residency
programs from 68.5% (178/260) in week 1 to 60.0% (156/260) in week 6; it was not statistically different (p = 0.054).

Acceptability Results
A total of 44 (22.2%) residents and 60 (25.3%) faculty that opened JiTT completed the survey. Table 1 shows the results
about the acceptability of JiTT infographics for residents.

As shown, 20 (45.5%) responded the role of resident as teach teacher “is one of my primary responsibilities”, 42 (90.9%)
felt that opening the infographics prompted them “to think about teaching”, 33 (75.0%) found the frequency to be just
right, and 31 (70.4%) changed their teaching styles as a result.

Table 1: Self-Reported Resident Survey Results (N = 44)

| Table 1: Self-Reported Resident Survey Results (N = 44) | Residents who responded "highly effective" or "moderately effective" | Mean [SD] |
|---------------------------------------------------------|---------------------------------------------------------------|----------|
| Rate the JiTT infographics tip sheets day of delivery   | 29 (65.9)                                                     | 3.23 [0.94] |
| Rate the JiTT infographics tip sheets time of delivery  | 29 (65.9)                                                     | 3.20 [0.95] |
| How effective were the (general) JiTT infographic tip sheets in... |                                      |          |
| Teaching with Limited Time                              | 30 (68.2)                                                     | 3.09 [0.80] |
| Setting Goals & Expectations                            | 30 (68.2)                                                     | 3.08 [0.86] |
| Directed Observation Through Teaching                   | 27 (61.4)                                                     | 3.10 [0.82] |
| Using Questioning as an Effective Tool for Teaching     | 31 (70.5)                                                     | 3.05 [0.88] |
| Bedside Teaching                                        | 29 (65.9)                                                     | 3.08 [0.94] |
| SFED Model of Feedback                                  | 20 (45.5)                                                     | 3.28 [0.88] |
| How effective were your JiTT infographic tip sheets specific to your clinical specialty? | 32 (72.7)                                                     | 3.05 [0.85] |

Abbreviations: JiTT, Just in Time Teaching; SFED, Self-Assessment Feedback/Facts Encouragement Direction

*Residents rated each of these items using a 4-point Likert scale (1 = not effective, 2 = slightly effective, 3 = moderately effective, 4 = highly effective)
Furthermore, 50 (83.3%) faculty felt the JiTT infographics were a useful resource to enhance faculty teaching skills in the clinical environment, whether with students or residents. 29 (48.3%) encouraged residents to review the JiTT infographics.

Despite these promising results, these findings only represented the acceptability and satisfaction among the limited end-users. However, further thematic analysis of qualitative data confirmed these findings (Table 2) with faculty solidifying the value of JiTT as well as their involvement to engage residents in the program and most important role model and develop resident skills to utilize the infographic content.

**Discussion**

In the current US and Canadian graduate medical education curriculums, residents have inadequate opportunity to learn how to teach due to limited time away from patient care responsibilities (Ravichandran et al., 2019; Arya et al., 2018; Sward, Ellis and Mercado, 2020). Kirkpatrick’s Evaluation Model guides programmatic evaluation of the impact of JiTT infographics on resident’s perception of their role as clinical teachers and faculty as role models. JiTT infographics has allowed us to positively influence resident’s perception of their teaching skills and reach Kirkpatrick level 1 (satisfaction) and level 2 (learning).

This study confirmed that infographics are adaptable to an array of clinical specialties and can be successfully implemented as a technology-enhanced pedagogical tool (Thoma et al., 2018; Chin et al., 2019; Dowhos et al., 2021) providing residents with the capacity to apply teaching skills ‘just in time’ in the clinical setting. A positive outcome was faculty satisfaction with the JiTT program and their ability to role model teaching skills, which leads to a positive aura of the JiTT program in the clinical environment. This also aligned with a recommendation from residents in an earlier pilot program that faculty must receive the same content as residents.

**Table 2: Themes about residents’ learning experience, with JiTT infographics**

| Theme                          | Subtheme                   | Representative quote                                                                 |
|-------------------------------|----------------------------|--------------------------------------------------------------------------------------|
| Overall perception of JiTT:   | Positive                   | It gave me ideas of what to go over with the students if students were present on my rotation. |
| Concise                       | The succinctly displayed information that could be utilized to enhance the teaching/learning experience. |
| Good Reminders                | Served as a reminder to always think about teaching |
| Negative                      | Too broad/general           | Could do with more specific examples, examples of good vs bad strategies |
| Became repetitive             | Grew repetitive and eventually did not look at them weekly |
| Improvements                  | More integrative            | Could be built into the curriculum in a more interactive way, weekly emails tend to get ignored |
| Content                       | I like the overall concept. I think more specific and advance topics could be sent out. Going over the abdominal exam or how to ask questions to the students is not beneficial. I want to teach them information that they can use for their examinations or future job. I want to let them take the lead on minor procedures (e.g., NG tubes, incision and drainage, etc.) and teach them specifics (how to diagnose and treat surgical conditions [cholecytis, peripheral vascular disease], which patients need operations, etc.). |

Abbreviations: NG, nasogastric
Finally, our system to launch the JiTT program included clinical specialty specific resident and faculty champions to assure the messaging about JiTT came from peers. This proved to be a very valuable starting point for this program to launch. From the focus group and surveys, we were able to ascertain several ways the JiTT infographics can improve its acceptability and usefulness which include: mini-podcast links attached to infographics making content audible and providing examples for each teaching tip; visual reminders of infographics in strategic locations, where they could be seen by faculty and residents; and changes in dissemination frequency by shortening the number of distribution weeks, use of a consortium-based approach (e.g. a blend of general and specialty-specific JiTT infographics). Recently, all infographics became available via a software application (App) (Supplementary File 4) to download on both iOS and Android devices. The adaptability of all content created for email distribution to electronic devices increases international end-user accessibility, especially since the JiTT infographic App is open access.

Limitations
There are several limitations to our study. First, selection bias may influence the survey data -- users who opened the JiTT infographics may be more likely to complete an emailed survey. Second, our study focused on the short-term impact on residents and faculty, specifically receptiveness to a new form of clinical education using visuals and technology. Our current evaluation was unable to measure the longitudinal impact on resident teaching or medical student learning. To determine an overall causative relationship between an educational innovation and teaching and learning outcomes may be difficult due to an array of confounding variables in our diverse clinical environments and the uniqueness of each clinical program. In addition, we need to further use our resident and faculty champions to understand program culture that impacts infographic initial and consistent open rates. These initial findings are a valuable first step and further studies will refine logistics and measurement of longer-term impact of infographics to determine RaT and faculty best practices in busy clinical environments.

Conclusion
In a mixed-method experiential study, we provided preliminary evidence that the creation of JiTT infographics is a viable technologically-enhanced strategy to develop and promote RaT in the clinical setting. Analysis showed the infographics were effective for 2 levels of Kirkpatrick to evaluate educational interventions. This adaptation to technology-assisted education that considers time sensitive delivery is especially important in light of the digital adeptness of residents and restricted duty hours. Most important we can say with certainty that the JiTT infographic program can be incorporated into diverse busy teaching and clinical settings. In addition it is accessible on open-access technological devices available in the clinical setting to ensure “just in time” access and application.

Take Home Messages
- JiTT infographics provides trainees and faculty with visually accessible evidence-based teaching tips to enhance skills ‘just in time’ in the clinical setting.
- Preliminary results illustrate this approach can be an effective way to engage trainees and faculty to teach medical students and junior trainees.
- The ‘just in time teaching tip’ is adaptable across clinical specialties and can be foundational and clinically specific.

Notes On Contributors
David Orner MPH, is a research coordinator in the Department of Radiation at Donald and Barbara Zucker School of Medicine at Hofstra/Northwell, New York. ORCID ID: https://orcid.org/0000-0002-2208-196X

Dr. Alice Fornari EdD; RDN, is the Vice President of Faculty Development at Donald and Barbara Zucker School of Medicine at Hofstra/Northwell, New York. ORCID ID: https://orcid.org/0000-0001-5475-2732

Dr. Sarah M. Marks MD., is a Psychiatry Resident (PGY3) at Donald and Barbara Zucker School of Medicine at Hofstra/ Northwell, New York. ORCID ID: https://orcid.org/0000-0002-9291-789X

Dr. Timothy R. Kreider MD., PhD, is the Clerkship Director of Psychiatry at Donald and Barbara Zucker School of Medicine at Hofstra/Northwell, New York. ORCID ID: https://orcid.org/0000-0002-0934-8244

Declarations
The author has declared that there are no conflicts of interest.
Ethics Statement
This research study was deemed exempt by the Northwell Health Institutional Review Board (IRB) as a supplementary educational tool.

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This article has not had any External Funding

Supplementary Files
Supplementary file 1 - Supplementary File 1.pdf
Supplementary file 2 - Supplementary File 2.pdf
Supplementary file 3 - Supplementary File 3.pdf
Supplementary file 4 - Supplementary File 4.pdf
Supplementary file 5 - JITT revision.docx

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- Melissa Affa for her contributions to the creation of the JITT infographics
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- Janet Corral, PhD for her origination of the JiTT conceptual framework and her willingness to share her professional expertise with colleagues to improve medical education across the continuum
- Supplementary 1 and 2 are from the JITT Infographic Series (https://libguides.hofstra.edu/mededresources/teachingresources) by Alice Formari licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License.

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Version 2

Reviewer Report 13 October 2021

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Haipeng Xiao
The First Affiliated Hospital, Sun Yat-sen University

This review has been migrated. The reviewer awarded 4 stars out of 5

Thank you for addressing the issues I have raised for the previous version. I have enjoyed reading the updated manuscript. My sincere wishes for the future works of these authors.

Competing Interests: No conflicts of interest were disclosed.

Reviewer Report 09 October 2021

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Anita Samuel
This review has been migrated. The reviewer awarded 4 stars out of 5

This is an interesting approach to disseminating information in time-constrained environments. Thank you for sharing the JITT resources that were created. They provide a clear idea of how you have used infographics. It would be helpful to include some information about how these resources were deployed. There's a passing reference in the Results to “weekly emails” which is the only information provided about deployment. One limitation that should be noted is that the evaluation at Kirkpatrick level 2 is based on self-reported data. There is no objective assessment of learning.
**Competing Interests:** No conflicts of interest were disclosed.

Reviewer Report 24 September 2021
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Ken Masters
Sultan Qaboos University

This review has been migrated. The reviewer awarded 4 stars out of 5

The authors have addressed the concerns I raised about Version 1 of their paper, and it is now an improved reading experience. I look forward to future research that they may perform in this area.

**Competing Interests:** No conflicts of interest were disclosed.

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**Version 1**

Reviewer Report 28 February 2021
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Haipeng Xiao
The First Affiliated Hospital, Sun Yat-sen University

This review has been migrated. The reviewer awarded 5 stars out of 5

Few would dispute that teaching ability is an important requirement for residents. This is why Resident as Teacher (RaT) curriculum is considered a significant part of the resident's training. This paper shows us an important and interesting approach to facilitate the development of RaT, using infographics as a novel Just-in-Time-Teaching (JiTT) tool, which helps the residents to teach 'just in time' in the clinical encounter. The study is instructive and practical, using a mix-method analysis, with adequate information clearly describing the JiTT infographics. Thank you very much for sharing the study of this novel approach to RaT curriculum. It is very helpful and inspiring. Although introduction in more detail to both the origin and
development of Just-in-Time-Teaching may be needed to facilitate readers’ understanding, this well-written paper should be recommended to among residents, faculty, and administrators of medical education to arouse their attention to the development of RaT as well as consideration about how to improve RaT education in the residency training program in China with an acceptable RaT curriculum.

Competing Interests: No conflicts of interest were disclosed.

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Ken Masters
Sultan Qaboos University

This review has been migrated. The reviewer awarded 4 stars out of 5

An interesting paper on using infographics as a just-in-time-teaching tool to develop residents as teachers. The paper clearly outlines the problem to be solved, as the need to train Residents as Teachers, but the lack of time because of increased clinical duties. The proposed solution was to distribute infographics, and to measure the engagement and perceived value. The examples supplied (both in the supplementary files and the link) give a good insight into the type and scope of work covered by the infographics. Overall, and mindful of the limitations, the paper is well-written, and describes a nice solid piece of research on a useful topic. Some areas that could benefit from attention:
• Only the name of the software used is supplied. As there are different versions (with different costs and potentials), more details should be given.
• The work and time and human resources should be described. If the paper is to have value to those who would like to follow this example, this information is crucial.
• Which software, if any, was used to theme the qualitative data?
• The Discussion is given as a single block of text, and it would be more easily readable if this were broken into smaller paragraphs. Thank you for a good paper. I look forward to version 2 that is strengthened by addressing these items and those raised by the other reviewers.

Competing Interests: No conflicts of interest were disclosed.

Reviewer Report 10 January 2021
https://doi.org/10.21956/mep.19145.r27682
Alexandra Webb
Australian National University

This review has been migrated. The reviewer awarded 4 stars out of 5

Thank you for sharing your initiative to promote the development of education skills of residents. It was interesting to learn about the practicalities of developing and implementing the infographics and the responses of users. Please see a few suggestions for the paper below.

1. It would be helpful to the reader to clarify the specific issue – is there insufficient time for formal instruction or teaching experience/practice or something else? – to define the gap that the infographics were designed to fill. It is a challenge for programs to allocate enough time to enhance their skills (Ravichandran et al., 2019; Habermehl, Habermehl and Kim, 2018; Lacasse and Ratnapalan, 2009).

2. Provide some more evidence and supporting citations here e.g. Mayers’ Principles of Multimedia Learning. Well-designed infographics can be understood faster than text alone and are twice as likely to be retained (Scott et al., 2016).

3. Clarify details about the infographic creation e.g. Who developed the infographics—the residents or faculty or both? Who determined the format, content, design etc.? Who provided an overview/review to check content, ensure consistency, quality control?

4. Consider rewording the following:
   a. Difficult sentence to read: Despite these promising results, these findings were only represented the acceptability and end-user satisfaction.
   b. Clarify if this refers to a software application (app): and finally the future use of an APP to store all infographics.

5. Incorporate a brief description of how and when residents get opportunities to receive feedback on their teaching from peers and/or faculty.

**Competing Interests:** No conflicts of interest were disclosed.

Reviewer Report 24 December 2020

https://doi.org/10.21956/mep.19145.r27680
and complex ideas into an image is an art allowing the viewer – here a teaching resident - to quickly comprehend and internalize an educational concept. The authors present the research on the effectiveness of their masterfully crafted infographics termed “JiTTs”, teaching tip sheets, which have been prepared for busy residents to convey a just-in-time -teaching point. This paper provides valuable introspection into using infographics as RaT components, including development, recruitment of champions for buy-in, dissemination, and generation of feedback data. I enjoyed reading the paper and appreciate the infographics provided with the data. One idea that comes to mind, is, using the easy-to-comprehend tip sheets as prompts for rounds and other educational meetings, and generate discussion on the topic. Overall, this is a great approach to inform education under time constraints which are transferable into any field of education with the ability to use visuals.

**Competing Interests:** No conflicts of interest were disclosed.