Urban-based Longitudinal Integrated Clerkship: A scoping review

HyeRin Roh (✉ hyerinr@gmail.com)

Inje University College of Medicine <https://orcid.org/0000-0002-3879-709X>

Jiyoung Yun

Inje University College of Medicine

SongYi Park

Dong-A university college of medicine

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Abstract

Background Reports about longitudinal integrated clerkship (LIC) mostly deal with rural-based LICs. Clinical clerkships usually take place in urban academic medical center (AMC). We need to explore how to implement LIC in urban AMC. Authors reviewed the existing literature focused on urban-based LIC (uLIC) to explore the features and challenges uLIC. '

Method Authors adopted the scoping review framework. Research questions were: (1) What are the characteristics of uLIC studies? (2) How did medical schools implement uLICs? (3) What were the challenges when implementing uLICs? and (4) What gaps exist in uLIC research? Authors reviewed 495 studies from an initial electric database search and selected 27 articles for inclusion, and extracted relevant data and organized the demographic information and details of the uLICs for each of medical school. Authors conducted a thematic analysis on the challenges of uLIC.

Results Twenty-five papers were published in the United States. Urban-based LICs were evaluated by participants' responses (n=13) and students' learning outcome (n=10). One paper discussed obstacles of uLIC implementation. Fourteen papers were reported by two medical schools (Harvard Medical School, University of California San Francisco College of Medicine). The two medical schools reported student selection methods and six medical schools reported student assessment methods. Challenges related to LICs included preceptors' burden about LIC education, students' concern about academic achievement, students' inability to adapt to LICs, shortage of educational resources of AMC, and lack of understanding about LICs.

Conclusion Research is needed to understand the long-term outcomes of uLICs and strategies to overcome challenges. Medical schools should prepare student support systems and faculty development programs to facilitate successful implementation of uLICs. Medical schools' and hospitals' resources and funding should be taken into careful consideration prior to implementing uLICs.

Background

Most medical schools' clinical curriculums are rotational block clerkships (RBCs). This approach was instituted based on the assumption that it provides increased learning opportunities by offering greater diversity of experience and exposure to more disciplines. In practice, too many subspecialties result in a fragmented learning experience where students are unable to explore the whole disease spectrum [1]. Frequent block transitions cause students to struggle with their roles and responsibilities [1–3]. Moreover, close relationships between students and patients and students and preceptors are unable to develop and continue. As a result, students experience a lack of supervision and role modeling and can undergo an erosion of empathy and enthusiasm [4, 5].

The longitudinal integrated clerkship (LIC) may provide solutions to overcome the problems associated with RBCs. An LIC is a clinical curriculum with a long duration which enables the student to simultaneously experience multiple disciplines and develop and maintain continuing relationships with their preceptor and patients [6, 7]. Compared with students who undertake RBSs, Students in LICs have well-developed patient-centered communication skills and display better higher-order clinical and cognitive skills. Moreover, students in LICs take on increased responsibility with patients and report higher levels of confidence when dealing with ethical dilemmas. Continuity of student–preceptor relationships facilitates incremental knowledge acquisition and progressive feedback [6, 8, 9].

Studies about LICs are primarily focused on reporting curriculum implementation, program evaluation, and comparison of the outcomes of LIC versus RBC. Studies report LICs in rural settings in Canada, Australia, South Africa, and the United States and include a diversity of topics and report a variety of purposes related to rural-based LICs [10–14]. There are many studies that report LICs in rural areas, but few reporting LICs in urban areas. One study by Poncelet and Hirsh et al detailed only two medical schools which implement LICs in an academic medical center (AMC) and did not report any medical school implementing LICs in urban community hospitals [6]. There have been no extensive review articles summarizing LICs in urban setting or in AMCs alone.

This study reviewed the literature reporting LICs in urban-based medical centers to provide medical educators with guidance for the successful implementation of urban-based LICs (uLICs). Four research questions guided this scoping review:

- 1) What are the characteristics of uLIC studies?
- 2) How did medical schools implement uLICs?
- 3) What were the challenges when implementing uLICs?

4) What gaps exist in uLIC research?

Methods

We adopted the scoping review framework outlined by Arksey and O'Malley [15]. A scoping review is used to explore basic data to map the research of a relatively new field of interest which has not previously been comprehensively reviewed. We chose this methodology to extensively investigate the existing studies on uLICs and identify the characteristics of publications. Here, we followed Arksey and O'Malley's scoping review framework which has the following five stages: (1) identifying the research question; (2) identifying relevant studies; (3) selecting studies; (4) charting the data; and (5) collating, summarizing, and reporting the results. As the research questions were identified in the introduction section, the method section will begin with stage two. This study is exempt from Institutional Review Board approval.

1. Identifying relevant studies

We (JY, SYP) searched the following core databases from their beginnings to the 31st of December 2018: Pubmed, Embase, Ovid Medline, and ERIC (search strategy is attached as a supplement file). The following search keywords were combined: longitudinal, integrated, interdisciplinary, clerkship(s), integrated circuit(s), clerk(s), clerked, urban, academic medical center, tertiary hospital, community hospital, undergraduate, medical school and medical student(s). Search terms were combined using the Boolean operator "AND" and "OR" to find the most appropriate publications. In addition, we manually searched the reference lists of all selected publications to identify other publications not found on the initial database search. We did not restrict publication type, but we did target only those written in English.

2. Selecting studies

1) Inclusion and exclusion criteria

We defined uLIC as an LIC at a teaching hospital-attached medical school in an urban area. We defined a teaching hospital as a medical school and hospital located in the same city where a student could move from hospital to hospital in half a day. "Teaching hospital" referred to academic medical centers, community hospitals, tertiary medical centers, and patient centered medical home. Patient centered medical home is an approach to the delivery of primary care that is patient-centered, comprehensive, team-based, coordinated, accessible, and focused on quality and safety [16].

Prior to publication selection, the inclusion criteria were as follows: (1) publication about an LIC in an urban undergraduate medical school; and (2) format of the publication is a commentary, case report, abstract, poster, or original article. We also included publications where the LIC was not fully described, but when additional information could be obtained through the Consortium for Longitudinal Integrated Clerkships (CLIC) website [7]. We excluded review articles and publications which referred to LICs in rural areas or those not associated with medical schools. We also excluded publications dealing with topics not related to LIC implementation, such as visit notice tools or career interest in LIC.

2) Selection of articles

The database search resulted in 495 publications. Two researchers (JY, SYP) excluded 267 duplicates and screened the title and abstract of the remaining 228 publications. The researchers excluded 171 publications because they covered other topics ($n = 114$), LIC was implemented in rural area ($n = 32$), items of the curriculum were not fully described in the publication ($n = 14$), or the publication was a review article ($n = 7$). Title and abstract screening resulted in 57 publications. We then conducted full text reviews. In the first full-text review, JY excluded 28 publications because they were not about the implementation of LICs ($n = 18$), LIC overlapped with other included publications ($n = 4$), they were review articles ($n = 4$), they did not cover a clinical clerkship course ($n = 1$), or they did not fit the LIC definition defined in the inclusion criteria ($n = 1$). A second full text review of the remaining 29 articles was performed by SYP. We (JY and SYP) discussed the publications and excluded a further two articles because one did not match the LIC definition used in the current study, and the other did not fully identify LIC. We also reviewed the references of the remaining 27 publications and found no additional publications to include. A total of 27 publications were finally included in this study (Fig 1).

3. Charting the data

Two researchers (JY, SYP) independently extracted data from the 27 included articles. We started the data extraction process by developing a data form. The data extraction process was carried out with three branches: (1) demographics of the publications were extracted, including authors, date of publication, country where the LIC took place, research purpose, research design, and evaluation method; (2) details of the LIC were extracted, including medical school, hospital setting, grade of student, number of students, duration, curriculum design, disciplines involved, and student assessment; and (3) challenges of the LICs were extracted, as well as any potentially relevant information about the challenges.

We charted and sorted the extracted data by each medical school into an excel spreadsheet. If the publication did not provide enough information, we identified additional information from the CLIC website or the website of the particular medical school [7]. The researchers (JY and SYP) reached agreement about article selection and data extraction through discussion. If a consensus was not reached, a third researcher (HR) made the final decision. The quality of included articles was not assessed because quality assessment falls outside the study remit of a scoping review.

4. Collating, summarizing and reporting the results

We selected relevant publications using a flow chart (figure1) and organized the publications' demographic information and details of the LICs for each of medical school. Using the method described by Braun and Clarke, we conducted a thematic analysis about the challenges of the uLICs reported in the literature [17]. This approach has six phases: (1) familiarizing oneself with data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing a report.

Following these phases, we (JY, SYP) re-read the data to become more familiar with and more deeply immersed in the content. We searched for patterns and meanings and exchanged ideas about points of interest in the articles. We then generated codes manually using a Microsoft Excel spreadsheet by converting the initial list of ideas about challenge into allocated codes (i.e. "insufficient number of preceptors"). Each coded idea was written on a post-it note (one idea per post-it). The notes were checked to ensure that each idea was represented and there were no duplicates. The post-its were then stuck to a wall and discussed and clustered until meaningful themes and subthemes emerged. The process was repeated until all ideas had their own cluster. The final themes were then defined and named.

Results

1. Demographics of articles

The author, year of publication, country, medical school, study purpose, and evaluation method of the 27 publications are summarized in Table 1. Publications were published between 1997 and 2017. Of the 27 papers, only three papers were published before 2009. Most of the papers (n = 25, 92.59%) were published in the United States, and two papers (n = 2, 7.40%) were published in Australia. Eight publications were from Harvard Medical School, six were from the University of California San Francisco College of Medicine, three were from the University of Colorado Denver School of Medicine, and two were from Flinders University. The other schools reported one study each. There was one article in which multiple medical schools were jointly involved.

Study purposes were as follows: program evaluation (n = 13; 48.15%), comparison of the effectiveness of LIC vs. RBC (n = 11; 40.74%), report about experiences of LIC implementation (n = 2; 7.41%), and identification of challenges of LIC implementation (n = 1; 3.70%). Of the 13 program evaluations, 11 evaluated participants' reactions to uLICs (Kirkpatrick model level 1), one evaluated learning outcomes (Kirkpatrick model level 2), and one evaluated both students' reactions to LIC and learning outcomes.

2. The characteristics of implementing uLICs

The characteristics of implementing uLICs are summarized in Table 2.

1) Medical school and teaching hospital setting

We identified the 12 medical schools that reported uLIC implementation. A search of medical schools' websites added a further four medical schools to the list, for a total of 16 medical schools. Ten medical schools conducted uLICs at urban community-based hospitals, five at tertiary medical centers, and one at a patient centered medical home.

2) Students

Longitudinal integrated clerkships were implemented in the third year of the curriculum at all medical schools except one, where it was implemented in the second year. The number of students in each group ranged from 3–29. One school implemented uLIC for all students and fifteen medical schools implemented uLIC in a portion of their student body only. There was a trend of gradually increasing the number of students participating in uLICs from a small number of pilots. Two medical schools reported that they selected students for participation randomly from among candidate students. Fourteen medical schools did not indicate their method of student selection.

3) Duration

The duration of uLICs varied from eight weeks to one year. One-year curriculums were most common (n = 13, 81.25 %). Two medical schools implemented LICs which were under 12 weeks duration.

4) Curriculum design and involved disciplines

Many medical schools did not report their curriculum design in detail. Two medical schools implemented LICs and RBCs in parallel streams. Four medical schools required students to experience both LICs and RBCs. Among them, two medical schools had LICs for short durations. Most medical schools reported uLICs which were based in ambulatory clinics. Three medical schools described a curriculum which was divided into inpatient and outpatient components. Six medical schools scheduled students to visit clinics for half a day, at the same time, once per week. Between three and nine disciplines were included in each of the LICs. The most common discipline included was internal medicine, followed by pediatrics, and then surgery.

5) Assessment

Six medical schools reported their assessment methods but few schools had assessment methods specifically for assessing uLIC students. Three medical schools assessed students using the shelf examination used by the National Board Medical Examiners or Objective Structured Clinical Examination to evaluate uLICs or compared their outcomes with RBCs. One medical school assessed students based on the preceptors' observation. No publications reported assessment criteria or items in detail.

3. The challenges of urban based LICs

Five themes, and 24 subthemes were derived from the 57 codes (Table 3).

1) Preceptors' burden about LIC education

There were 13 codes under the theme "preceptors' concerns about LIC." The subthemes derived from these codes were as follows: Preceptors felt that LIC education was a burden [18, 22, 23, 34, 36]; LICs prevented preceptors from doing clinical work [23, 29, 34, 36]; preceptors felt that their reward was too small compared to the time and effort they input [23, 27, 38]; and preceptors had difficulties with student assessment [29, 44].

2) Students' concern about academic achievement

There were 18 codes under the theme "students' complaints about LICs." Subthemes derived from these codes were as follows: students complained that they learned nothing from their preceptors [18, 22, 27, 39]; students were afraid about not receiving feedback on their performances midway through the semester [23]; students were concerned about their end-of-semester assessment [19, 20, 23]; and students had difficulties in their independent learning [26].

3) Students' inability to adapt to LIC

The code "students' inability to adapt to LIC" had the following subthemes: faculty had difficulty selecting students for participation in LICs [38]; students could not adjust to LICs [37]; students abandoned LICs [18]; faculty had difficulty identifying students with problems early [22]; student support systems did not work during their LICs [22].

4) Shortage of educational resources of AMC

There were 19 codes under the theme "shortage of educational resources of AMC." Subthemes derived from these codes were as follows: shortage of administrative staff to assist with LIC implementation [23, 35, 37]; inadequate preceptors to teach students in LICs [18, 23, 35]; students were unable to meet various types of patients because of their preceptors' subspecialties [23, 35]; limited space in

hospitals for LIC [22, 23, 29, 38, 40, 41]; LICs required significant financial resources [23, 27, 37]; and students' schedules it were complicated to make [18, 23, 25, 35]; and students had to move long distances on a tight schedule [18, 23].

5) Lack of understanding about LIC

There were nine codes under the theme "lack of understanding about LIC." Subthemes derived from these codes were as follows: no one with in-depth knowledge about LICs [37]; students were unable to understand the purpose of LICs [20]; participants had difficulties comprehending the advantages of LICs [35]; and participants were doubtful about the cost effectiveness of LICs [35, 37].

Discussion

This study reviewed existing uLIC studies to provide guidance for the successful implementation of uLICs. Specific challenges to uLIC reported in the literature are as follows: student support systems did not work well when the students had problems; students were dissatisfied with the structure LICs and RBCs in parallel streams; there were difficulties considering both medical schools and teaching hospitals in schedule management; participants (student, preceptor and education administrators) lacked an understanding about the complex process of implementing LICs; and preceptors did not know how to teach and assess students. Publications did not identify the following processes: how to select students for participation in uLICs, how to assess students in uLIC-RBC parallel streams at the same hospital, how to develop and implement appropriate student schedules, or how to recruit preceptors for uLICs.

To fill the gaps of in the research about uLICs

Implementation of uLIC across the entire student population may be one way to address students' complaints and manage problems related to student selection to assessment. However, this would require significant funding, administrative support, a large number of preceptors and a large hospital which would be practically prohibitive with the situation of each medical school and teaching hospital. Thus, inevitably LICs will initially need to be implemented among a small number of students. In order to select students to participate in uLICs effectively, educators should not only consider students' grades, but should also ensure students fully understand the goals and learning processes. After the LIC has commenced, educators must stay heavily involved in the program to maintain and manage students' and preceptors' satisfaction as well as optimal outcomes. Assessment methods should be specifically designed for students in uLICs and deliver feedback in a timely manner. Assessment methods must be different from those of students in parallel RBCs.

Schedule management is at the core of the successful practical implementation of uLICs. Urban-based LICs should include the number of disciplines which can be comfortably managed by the administrators with particular attention focused on the management students' schedules. Faculty development about LICs is necessary to facilitate recruitment of preceptors and provide instruction to preceptors about how to teach and assess students, how to anticipate what problems students may have, and how to discuss with students what they need. Preceptors should be provided with time and financial reward for faculty development.

We make the following recommendations: (1) uLIC should be implemented among a small number of students; (2) student selection should be appropriate and student support systems should work in a timely manner; (3) fewer disciplines should be included for effective schedule management; (4) medical schools should provide time and financial reward for faculty development related to uLIC.

Recommendations for Future Research

The publications in this study primarily focused on program evaluation and comparing LICs with RBCs. According to the Kirkpatrick model, uLICs should be evaluated by learner behavior and result [49]. To do so, uLIC students must be the subjects of longitudinal research. Ideally, the knowledge and skills of post-graduate trainees who participated in uLICs should be observed, and patient outcomes should be assessed. This kind of study would be advantageous because it would help educational directors make decisions about whether to implement uLICs, or whether to continue current uLICs.

Investigation of strategies to overcome the challenges identified in this study should continue. The challenges mentioned in 27 publications were sometimes not specific to uLICs. The context of the thematically analyzed codes was only speculated by the researchers so we cannot be certain we clearly understood their true meaning and what the actual problems were. Moreover, we could

not identify specific solutions to the problems identified. Therefore, to find strategies to overcome challenges specific to uLICs, future studies should focus on identifying the real problems of each participant and the practical shortage of specific resources in their context.

Through 27 publications and four websites, we identified different uLIC programs at 16 medical schools. Most publications were from the United States and two were from Australia. Because we searched for English articles only, we did not include data from studies not published in English. Above all, there are only a few medical schools with teaching hospitals that are well-funded and scalable for LIC implementation. Urban-based LIC implementation characteristics in this study are not applicable to medical school in Korea without modification. Future research is required to observe the nature of uLICs in diverse countries, including Asian countries.

Conclusions

Medical schools should prepare student support systems and faculty development programs to facilitate the successful implementation of uLICs. Medical schools' and hospitals' resources and funding should be taken into careful consideration prior to implementing uLICs. More research is needed to report long-term outcomes and strategies for overcoming challenges associated with uLIC in various contexts.

Declarations

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Abbreviation

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Ethics approval and consent to participate

This study was exempt from IRB review of Dong-A university on the 3rd July 2019.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interest.

Authors' contributions

HR JY designed the research with conception. JY and SYP collected the data and JY, SYP, and HR analyzed and interpreted the data. JY initially drafted the manuscript and JY, SYP and HR revised it critically. All authors read and approved the final manuscript.

RBC: Rotational Block Clerkship

LIC: Longitudinal Integrated Clerkship

uLIC : urban-based LIC

AMC: Academic Medical Center

References

References

1. Holmboe E, Ginsburg S, Bernabeo E. The rotational approach to medical education: time to confront our assumptions? *Med Educ*. 2011;45(1):69–80.
2. Radcliffe C, Lester H. Perceived stress during undergraduate medical training: a qualitative study. *Med Educ*. 2003;37(1):32–8.
3. O'Brien B, Cooke M, Irby DM. Perceptions and attributions of third-year student struggles in clerkships: do students and clerkship directors agree? *Acad Med*. 2007;82(10):970–8.
4. Crandall SJ, Marion GS. Commentary: identifying attitudes towards empathy: an essential feature of professionalism. *Acad Med*. 2009;84(9):1174–6.
5. Feudtner C, Christakis DA, Christakis NA. Do clinical clerks suffer ethical erosion? Students' perceptions of their ethical environment and personal development. *Acad Med*. 1994;69:670–679.
6. Poncelet A, Hirsh D. *Longitudinal Integrated Clerkships: Principles, Outcomes, Practical Tools, and Future Directions: Gegensatz Press*; 2016.p165–184
7. The Consortium of Longitudinal Integrated Clerkships website. <https://climed.com>. Accessed 3 Jan 2018
8. Walters L, Greenhill J, Richards J, Ward H, Campbell N, Ash J, Schuwirth LW. Outcomes of longitudinal integrated clinical placements for students, clinicians and society. *Med Educ*. 2012;46(11):1028–41.
9. Hirsh DA, Ogur B, Thibault GE, Cox M. "Continuity" as an organizing principle for clinical education reform. *N Engl J Med*. 2007;356(8):858–66.
10. Worley P, Couper I, Strasser R, Graves L, Cummings BA, Woodman R, Stagg P, Hirsh D. A typology of longitudinal integrated clerkships. *Med Educ*. 2016;50(9):922–32.
11. Norris TE, Schaad DC, DeWitt D, Ogur B, Hunt DD. Longitudinal integrated clerkships for medical students: an innovation adopted by medical schools in Australia, Canada, South Africa, and the United States. *Acad Med*. 2009;84(7):902–7.
12. Couper I, Worley PS, Strasser R. Rural longitudinal integrated clerkships: lessons from two programs on different continents. *Rural Remote Health*. 2011;11(2):1665.
13. Hudson JN, Knight PJ, Weston KM. Patient perceptions of innovative longitudinal integrated clerkships based in regional, rural and remote primary care: a qualitative study. *BMC Fam Pract*. 2012;13(1):72.
14. Hudson JN, Weston KM, Farmer EA. Engaging rural preceptors in new longitudinal community clerkships during workforce shortage: a qualitative study. *BMC Fam Pract*. 2011;12(1):103.
15. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int. J. Social Research Methodology*. 2005;8(1):19–32.
16. Patient-Centered Primary Care Collaborative website. <http://www.pcpcc.org/>. Accessed 15 Nov 2018
17. Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology*. 2006;3(2):77–101.
18. Yonke A, Lemon M. Shaping the third year of a primary care program in a tertiary care environment. *Acad Med*. 1997;72(5):436.
19. Yu M, Hawley C, Towns AB. A year-long longitudinal third-year clerkship in an inner-city health center designed to maximize continuity. *Acad Med*. 1997;72(5):439–40.
20. Peters AS, Schnaidt KN, Seward SJ, Rubin RM, Feins A, Fletcher RH. Teaching care management in a longitudinal primary care clerkship. *Teach Learn Med*. 2005;17(4):322–7.
21. Hansen L, Simanton E. Comparison of third-year student performance in a twelve-month longitudinal ambulatory program with performance in traditional clerkship curriculum. *S D Med*. 2009;62(8):315–7.
22. Shaffer K, Ng JM, Hirsh DA. Development of a Year-long Curriculum in Imaging with Focus on Ambulatory and Multidisciplinary Medicine. *Acad Radiol*. 2009;16(10):1292–301.
23. Poncelet A, Bokser S, Calton, B, Hauer KE, Kirsch H, Jones T, Lai CJ, Mazotti L, Shore W, Teherani A, Tong L, Wamsley M, Robertson P. Development of a longitudinal integrated clerkship at an academic medical center. *Med Educ Online*. 2011;16.
24. Ghosh A, Hirsh DA, Ogur B, Schwaitzberg SD. Teaching medical students about cancer impact through a longitudinal surgical experience: a case study. *Teach Learn Med*. 2012;24(2):158–62.

25. Griswold T, Bullock C, Gaufberg E, Albanese M, Bonilla P, Dvorak R, Epelbaum C, Givon L, Kueppenbender K, Joseph R, Boyd JW, Shtasel D. Psychiatry in the Harvard Medical School-Cambridge Integrated Clerkship: an innovative, year-long program. *Acad Psychiatry*. 2012;36(5):380–7.
26. Haspel RL, Bhargava P, Gilmore H, Kane S, Powers A, Sepehr A, Weinstein AR, Schwartzstein R M, Roberts DH. Successful implementation of a longitudinal, integrated pathology curriculum during the third year of medical school. *Arch Pathol Lab Med*. 2012;136(11):1430–6.
27. Hirsh D, Gaufberg E, Ogur B, Cohen P, Krupat E, Cox M, Pelletier S, Bor D. Educational outcomes of the Harvard Medical School-Cambridge integrated clerkship: a way forward for medical education. *Acad Med*. 2012;87(5):643–50.
28. Mazotti LA, Guerra J, Siu S, Brickner L, Smith W, Poncelet A. Establishing KLIC-the UCSF-kaiser permanente longitudinal integrated clerkship. *J Gen Intern Med*. 2012;27:S556-S7.
29. Meah YS, Gault A, Naderi NR, Soriano RP, Parkas V. Developing a longitudinal interdisciplinary clerkship (LIC) ATAN urban tertiary medical center: The mount Sinai interact program. *J Gen Intern Med*. 2012;27:S554-S5.
30. O'Brien BC, Poncelet AN, Hansen L, Hirsh DA, Ogur B, Alexander EK, Krupat E, Hauer KE. Students' workplace learning in two clerkship models: a multi-site observational study. *Med Educ*. 2012;46(6):613–24.
31. Henschen BL, Garcia P, Jacobson B, Ryan ER, Woods DM, Wayne DB, Evans, DB. The patient centered medical home as curricular model: perceived impact of the "education-centered medical home". *J Gen Intern Med*. 2013;28(8):1105–9.
32. Suri A, E-B A, Ziehr DR, Jastrzembski B, Morris JE, Wagner A, Patino A, Mallampati D, Bor D, Hirsh D, Gaufberg E. Cambridge integrated clerkship systems rounds: Medical student-driven quality improvement and patient advocacy. *J Gen Intern Med*. 2013;28:S456.
33. Teherani A, Irby DM, Loeser H. Outcomes of different clerkship models: longitudinal integrated, hybrid, and block. *Acad Med*. 2013;88(1):35–43.
34. Banh K, Ramirez R, Thabit C. Effectiveness of emergency medicine in longitudinal integrated clerkships. *Med Educ Online*. 2014;19:25429.
35. Heddle W, Robertson G, Mahoney S, Walters L, Strasser S, Worley P. Challenges in transformation of the "traditional block rotation" medical student clinical education into a longitudinal integrated clerkship model. *Educ Health (Abingdon)*. 2014;27(2):138–42.
36. Melo J, Kaneshiro B, Kellett L, Hiraoka M. The impact of a longitudinal curriculum on medical student obstetrics and gynecology clinical training. *Hawaii J Med Public Health*. 2014;73(5):144–7.
37. Poncelet AN, Mazotti LA, Blumberg B, Wamsley MA, Grennan T, Shore WB. Creating a longitudinal integrated clerkship with mutual benefits for an academic medical center and a community health system. *Perm J*. 2014;18(2):50–6.
38. George P, Tunkel AR, Dollase R, Gruppuso P, Dumenco L, Rapoza B, Borkan J. The Primary Care-Population Medicine Program at The Warren Alpert Medical School of Brown University. *R I Med J* (2013). 2015;98(9):16–21.
39. Mahoney S, Worley P, Parry H, Clarke S. Urban general practice and medical education: Academic outcomes from a unique urban, longitudinal integrated community-based program. *Aust Fam Physician*. 2016;45(10):754–7.
40. O'Brien BC, Hirsh D, Krupat E, Batt J, Hansen LA, Poncelet AN, Ogur B, Hauer KE. Learners, performers, caregivers, and team players: Descriptions of the ideal medical student in longitudinal integrated and block clerkships. *Med Teach*. 2016;38(3):297–305.
41. Ari M, Michelle C, Gong J, Adams J. Reflective practice within the denver health longitudinal integrated clerkship (DH-LIC): A curricular space to build professional identity & resilience. *J Gen Intern Med*. 2017;32(2):S702.
42. Diuguid-Gerber J, Porter S, Quiah SC, Nickerson K, Jones D, Audi Z, Richards BF. The Columbia-Bronx VA amalgamative clerkship: an effective, 12-week, integrated, longitudinal clinical experience. *Med Educ Online*. 2017;22(1):1301630.
43. Felder-Heim C, Kvach E, Powell K, Adams J. Preparing medical students for working with LGBTQ patients through the assessment of educational needs and the development of an LGBTQ health curriculum in the denver health longitudinal integrated clerkship (DH-LIC). *J Gen Intern Med*. 2017;32(2):S700.
44. Snow SC, Gong J, Adams JE. Faculty experience and engagement in a longitudinal integrated clerkship. *Med Teach*. 2017;39(5):527–34.
45. Longitudinal Integrated Clerkship Program. <https://medschool.duke.edu/education/degree-programs-and-admissions/longitudinal-integrated-clerkship-program/about-program>. Accessed 21 Feb 2019
46. Doctor of Medicine Program. <https://www.geisinger.edu/education/academics/md-program/md-program-year-3>. Accessed 21 Feb 2019

47. Tuscaloosa Campus. <https://www.uab.edu/medicine/home/campuses/tuscaloosa-campus>. Accessed 21 Feb 2019

48. Translational Education at Carolina Overview. <https://www.med.unc.edu/md/curriculum/tec-curriculum-information/>. Accessed 21 Feb 2019

49. Frye AW, Hemmer PA. Program evaluation models and related theories: AMEE Guide No. 67. Med Teach. 2012;34:e288–299.

Tables

Table 1. Demographics of articles

	Author	Year	Country	School	Study purpose	Evaluation method
1	Yonke A., et al.[18]	1997	USA	Chicago college of Medicine, University of Illinois.	To evaluate program	Feedback conference
2	Yu M., et al. [19]	1997	USA	Charles R. Drew University of medicine and science.	To evaluate program	Student's response survey
3	Peters AS., et al. [20]	2005	USA	Harvard Medical School.	To evaluate program	Student written report
4	Hansen L., et al. [21]	2009	USA	Sanford school of Medicine, University of South Dakota.	To compare effectiveness of LIC and RBC	NBME subject exam scores
5	Shaffer K., et al. [22]	2009	USA	Harvard Medical School.	To compare effectiveness of LIC and RBC	OSCE, Final exam score, Choice of specialty
6	Poncelet A., et al. [23]	2011	USA	University of California San Francisco, College of Medicine.	To compare effectiveness of LIC and RBC	NBME subject exam scores, SP (Standardized patient) exam, Student's response survey
7	Ghosh A., et al. [24]	2012	USA	Harvard Medical School.	To evaluate program	Student's response survey
8	Griswold T., et al. [25]	2012	USA	Harvard Medical School.	To compare effectiveness of LIC and RBC	OSCE, NBME subject exam scores,

						Student written report Observed clinical work
9	Haspel RL., et al. [26]	2012	USA	Harvard Medical School.	To evaluate program	Student's response survey
10	Hirsh D., et al. [27]	2012	USA	Harvard Medical School.	To compare effectiveness of LIC and RBC	Admission Test scores (baseline), USMLE Step 1 scores, OSCE, PPOS
11	Mazotti LA., et al. [28]	2012	USA	University of California San Francisco, College of Medicine.	To report experience of implementation	NBME subject exam scores,
12	Meah YS., et al. [29]	2012	USA	Mount Sinai School of Medicine, New York.	To evaluate program	BSCO, RIME
13	O'Brien, BC., et al. [30]	2012	USA	University of California San Francisco, College of Medicine.	To compare effectiveness of LIC and RBC	Observational work sampling
14	Henschen, BL., et al. [31]	2013	USA	Northwestern University Feinberg School of Medicine	To evaluate program	Student's response survey Feedback conference
15	Suri A., et al. [32]	2013	USA	Harvard Medical School	To evaluate program	Feedback conference
16	Teherani A., et al. [33]	2013	USA	University of California San Francisco, College of Medicine.	To compare effectiveness of LIC and RBC To identify perception	USMLE Step 2 CS

					difference of LIC and RBC	Focus group interview
17	Banh K., et al. [34]	2014	USA	University of California San Francisco, College of Medicine.	To evaluate program	Student's response survey Patient's response survey
18	Heddle W., et al. [35]	2014	Australia	School of medicine, Flinders University.	To identify challenges of LIC implementation	Feedback conference
19	Melo J., et al. [36]	2014	USA	John A. Burns School of Medicine, University of Hawaii.	To compare effectiveness of LIC and RBC	NBME subject exam scores
20	Poncelet, AN., et al. [37]	2014	USA	University of California San Francisco, College of Medicine.	To compare effectiveness of LIC and RBC	NBME subject exam scores
21	George P., et al. [38]	2015	USA	Warren Alpert Medical School of Brown university.	To report experience of implementation	
22	Mahoney S., et al. [39]	2016	Australia	School of medicine, Flinders University.	To compare effectiveness of LIC and RBC	OSCE
23	O'Brien BC., et al. [40]	2016	USA	University of California San Francisco College of Medicine; Harvard Medical School; Sanford school of Medicine, University of South Dakota.	To identify perception difference of LIC and RBC	Interview of students & preceptors
24	Ari M., et al.[41]	2017	USA	University of Colorado School of Medicine.	To evaluate program	Student written report, Focus group interview
25	Diuguid- Gerber	2017	USA	College of Physicians and Surgeons, Columbia University.	To evaluate program	Feedback session

J.,et al.

[42]

26	Felder- Heim C., et al.[43]	2017	USA	University of Colorado School of Medicine.	To evaluate program	Student's response survey
27	Snow SC., et al.[44]	2017	USA	University of Colorado School of Medicine.	To evaluate program	Preceptor's response survey

NBME National Board of Medical Examiners

OSCE Objective Structured Clinical Examination

SP Standardized Patient

USMLE United States Medical Licensing Examination

CS Clinical Skill

PPOS Patient-Practitioner Orientation Scale

BSCO Brief Structured Clinical Observations

RIME Reporter, Interpreter, Manager, Educator

Table 2. The characteristics of implementing urban-based LICs

Medical school	Setting	Grade of student	No of student	duration	Design	Disciplines	Assessment
Harvard Medical School [20,22,24,25,26,27,32,40]	Community based hospital	2	8~12	1yr	LIC and RBC parallel streams	IM, Ped, Neu, Psy, GS, OB/GYN	NBME subject exams, OSCE, Clinical write-ups, Mid-year assessment involving all specialties
University of California San Francisco College of Medicine [23,28,30,33,34,37,40]	Tertiary medical center	3	9~16	1yr	LIC and RBC parallel streams	FM, IM, Neu, Psy	RIME, NBME subject exams
University of Colorado school of medicine, Denver[41,43,44]	Community based hospital	3	8	1yr	Inpatient(shortly) & Outpatient (remainder of year)	GS, IM, Neu, OB/GYN, Ped, Psy	
Sanford school of Medicine, University of South Dakota [21,40]	Community based hospital	3	21	1yr	Ambulatory setting	IM, Ped, Psy, OB/GYN, GS	NBME subject exams
School of medicine, Flinders University [35,39]	Community based hospital	3	23			Ped, IM, OB/GYN, Psy, GS, General Practice, EM	
John A. Burns School of Medicine, University of Hawaii.[36]	Community based hospital	3	28	6 months	Ambulatory setting	FM, IM, OB/GYN, Ped, Psy, GS	NBME subject exams

Warren Alpert medical school of Brown university [38]	Community based hospital	3	24	1yr	Inpatients(12wks) & Outpatients(32wks) & Elective(4wks)	FM, GS, IM, OB/GYN, Neu, Ped, Psy	Subject exams, OSCE, Direct observation
College of Physicians and Surgeons, Columbia University [42]	Tertiary medical center	3	4	12wks	Both LIC and RBC in a year	Primary care, IM, Orthopedics, Urology	
Northwestern University Feinberg School of Medicine [31]	Community based hospital (PCMH)	3	14	1yr			
Mount Sinai School of Medicine [29]	Tertiary medical center	3	8~11	8~11wks	Both LIC and RBC in a year	Ped, General Medicine, Geriatrics, Homebound medicine, GS	NBME subject exams
Chicago college of Medicine, University of Illinois [18]	Tertiary medical center	3	12	1yr	Ambulatory setting (half a day every week in preceptor's office)		
Charles R. Drew univ of medicine and science, Los Angeles [19]	Community based hospital	3	29	30wks	Ambulatory setting (half a day every week in preceptor's office)	FM, IM, Ped, OB/GYN, Psy	
Duke university School of Medicine [45]	Tertiary medical center	3		1yr	Inpatient(4month) & Outpatient (8 months)	adult medicine, FM, primary care, Ped, GS	

					Psy, Neu, GS, IM, Ped, OB/GYN
Geisinger Commonwealth School of Medicine [46]	Community based hospital	Total	1yr	Both LIC and RBC in a year	Med, FM, Ped, GS, OB/GYN, Psy
The University of Alabama School of Medicine, Tuscaloosa Campus [47]	Community based hospital		1yr	Both LIC and RBC in a year	
University of North Carolina School of Medicine [48]	Community based hospital	4	1yr	Inpatient & Outpatient	GS, IM, Psy, Ped, Neu, OB/GYN, EM, FM, Psy

The blanks were not found in the papers or on the web sites.

LIC Longitudinal integrated clerkship

RBC Rotational Block Clerkship

M Internal Medicine

GS General Surgery

OB/GYN obstetrics-gynecology

FM family medicine, Rad radiology

RM Rehabilitation Medicine

EM Emergency Medicine

Ped pediatrics

Neu neurology

Psy psychiatry

Table 3. Thematic analysis of challenges in LIC implementation.

Theme	Subtheme	Reference articles
Preceptors' burden of LIC education	Preceptors felt that LIC education was a burden.	18,22,23,34,36
	LICs prevented preceptors from doing clinical work.	23,29,34,36
	Preceptors felt that their reward was too small compared to the time and effort they input.	23,27,38
	Assessment of LIC students is another burden.	29,44
Students' concern about academic achievement	Students complained that they learned nothing from their preceptors.	18,22,27,39
	Students were afraid about not receiving feedback on their performances midway through the semester.	23
	Students were concerned about their end-of-semester assessment.	19,20,23
	Students had difficulties in their independent learning.	26
Students' inability to adapt to LIC	Faculty had difficulty selecting students for participation in LICs	38
	Students could not adjust to LICs	37
	Students abandoned LICs	18
	Faculty had difficulty identifying students with problems early	22
	Student support systems did not work during their LICs	22
Shortage of educational resources of AMC	Shortage of administrative staff to assist with LIC implementation	23,35,37
	Inadequate preceptors to teach students in LICs	18,23,35
	Students were unable to meet various types of patients because of their preceptors' subspecialties.	23,35
	Limited space in hospitals for LIC	22,23,29,38,40,41
	LICs required significant financial resources.	23,27,37
	Students had to move long distances on a tight schedule.	18,23
	Students' schedules it were complicated to make.	18,23,25,35
Lack of understanding about LIC	No one with in-depth knowledge about LICs	37

Students were unable to understand the purpose of LICs	20
Participants had difficulties comprehending the advantages of LICs	35
Participants were doubtful about the cost effectiveness of LICs	35,37

Figures

Fig 1. Study selection flow chart

Figure 1

Flow chart