Research

Longitudinal integrated clerkship engagement of clinical associate students in South Africa: Evidence of e-logbook data

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Background. Clinical associate (ClinA) students from various clinical learning centres (CLCs) need to show timely evidence of their longitudinal integrated clerkship (LIC) exposure; therefore, an electronic logbook was introduced.

Objective. To describe patients logged by second- and third-year ClinA students during their LIC rotation in 2022 from 15 CLCs in four South African provinces.

Method. This study was a retrospective cross-sectional analysis of patients logged in 2022 by students in hospitals and clinics. Second- and third-year ClinA students were allocated to rural and urban CLCs where patient logging was done electronically.

Results. Across 15 CLCs, 88 ClinA students logged 26 392 patients. The age range of the patients was between 0 days and 106 years. Of the 12 925 patients logged by third-year students, most patients (28%) were logged in the emergency medicine discipline. Second-year students logged most patients in the musculoskeletal theme (18% of 13 406). The students selected specific diagnoses for 12 417 patients. The top five diagnoses were: HIV (*n*=3 217), hypertension (*n*=3 173), trauma (*n*=2 223), pregnancy related (*n*=2 123) and diabetes (*n*=1 734). Second-year students did not log many paediatric and mental health patients.

Conclusion. Because of authentic learning and exposure to various diagnoses, patients and procedures during their LIC, ClinA students will most likely be well prepared for the workplace. The students' e-logbook data recorded during LIC demonstrate their clinical exposure and learning opportunities.

Keywords: longitudinal integrated clerkships, clinical associates, physician associate, e-logbooks, clinical learning centres

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Clinical associate (ClinA) students are fast becoming integral members of healthcare teams in South Africa (SA) and are trained by completing a Bachelor of Clinical Medical Practice (BCMP) programme. ClinA students are physician associates/physician-associate comparable, who are classified by the 2012 International Labour Organization International Standard Classification of Occupations as paramedical practitioners who 'provide advisory, diagnostic, curative and preventive medical services more limited in scope and complexity than those carried out by medical doctors'.[1] 'They work autonomously, or with limited supervision of medical doctors, and apply advanced clinical procedures for treating and preventing diseases, injuries and other physical or mental impairments common to specific communities.'[2,3]

The dialogue to start the BCMP programme was initiated in 2004[4] to address human resource needs in SA healthcare services.[5-7] Walter Sisulu University was the first to offer a BCMP programme (2008), followed by the University of Pretoria (UP) (2009) and the University of the Witwatersrand (2009). These universities use different teaching strategies in their BCMP programmes. Two universities adopted problem-based learning and didactic training.[8] UP adopted a competency-based model enhanced by whole-brain learning theory and a decentralised teaching method that includes clinical rotations,[9] where the students are allocated to several clinical learning centres (CLCs), each under the mentorship of a facilitator.[7] CLCs are hospitals or health facilities where students practise patient consultations, perform procedures and manage patients while collaborating with and learning from qualified health professionals. These learning opportunities foster resilience and in-depth reflection on students' learning and professional development.[10] UP's philosophy of teaching and learning includes self-directed learning,[11] authentic learning[12] and the promotion of patient-centred care,[13,14] which offers students various learning opportunities[4] to accommodate different thought processes.[10]

A longitudinal integrated clerkship (LIC) is a medical education model that includes strategies to promote authentic learning and is increasingly employed by medical schools in countries such as the USA, Canada, Australia, New Zealand and SA.[15,16] LICs employ different learning models, but their core elements remain the same. These core elements include the participation of students in comprehensive patient care, continuing learning relationships with clinicians while meeting the year's core competencies simultaneously across multiple disciplines.[16,17] Continuity of care is an important aspect in LIC.[15] Students are assigned to a patient for the duration of the patient's hospital stay and they follow up the patient through different departments.[15] In SA, LICs fall into two broad models. One model is predominantly a community-based rural or remote family medicine setting, and the other is a secondary or tertiary care setting supervised by clinicians from various disciplines.[15]

At UP, ClinA students spend most of their 3 years doing service learning on a decentralised learning platform at CLCs in an LIC model. Typically, each CLC comprises a district-level public hospital and its surrounding

clinics.[18] A local family physician oversees and leads student learning in each CLC. The students have daily contact with patients and conduct consultations under the supervision of qualified health professionals such as doctors, ClinAs and nurses, all of whom form part of an authentic curriculum. This study describes the patients logged by second- and third-year ClinA students during their clinical training for 2022.

Methodology

Study design

This study was a retrospective cross-sectional analysis of electronic logbook (e-logbook) data from 2022 submitted by ClinA students engaged in an LIC.

Setting

During their second and third years, ClinA students at UP spend at least 28 hours per week learning through clinical practice in an LIC at various CLCs. Second-year students focus their learning on themes based on body systems, each with a dedicated number of weeks, reaching a total of 32 weeks per year. Third-year students rotate for a set number of weeks in each major medical discipline. The number of weeks differs per discipline, reaching a total of 34 weeks for the year. All students were expected to log 20 patients per week of clinical training.

Between February and November 2022, 94 ClinA students were allocated to 15 CLCs across four provinces. Unfortunately, six students did not complete the training and were not included in the analysis. The students were allocated to eight hospitals in Mpumalanga, two hospitals in KwaZulu-Natal, one hospital in Limpopo and four hospitals in Gauteng. Table 1 shows the profiles of these hospitals per province.

In all the hospitals, second-year students were expected to rotate in family medicine and primary healthcare, rehabilitation, internal medicine, surgery, obstetrics, paediatrics, orthopaedics, eye care, the outpatient department, as well as the emergency department. Third-year students did not rotate in eye care and rehabilitation, but rotated in all the other areas, as well as gynaecology, anaesthesia, psychiatry and in the operating theatre.

The number of students hosted by hospitals varied because of accommodation availability and supervisory capacity at each CLC. All clinical work was recorded in Qualtrics (Qualtrics, USA) (an online survey platform for gathering and analysing data).

Data collection

All the ClinA students were taught how to use Qualtrics as an e-logbook in their first year of the BCMP programme. This platform has cloud servers that securely store data. The e-logbook captures student, patient and consultation details. The students log patients when they have data or WiFi connectivity. All the students used Qualtrics to log a specific number of patients per week. Students entered the details of their patient engagements into Qualtrics daily. In addition to free text descriptions of diagnoses, students could select ≥1 of 13 common diagnoses for each patient. Submissions were allowed up to seven days after the actual encounter, after which entries were accepted only after the supervising clinician verified the late entry.

Study population

The study population comprised a cohort of students enrolled in year 2 and year 3 of the BCMP programme in 2022, who were allocated to 15 CLCs and who completed their full year of practical work-integrated learning. This cohort of students was selected based on their competence in using Qualtrics throughout the year and being at an advanced stage of their learning. The records of their learning encounters with patients are included in this study.

Data analysis

The data were exported from the Qualtrics online survey platform to Microsoft Excel (Microsoft, USA) for cleaning. Records without a chief complaint or clinical assessment (in the relevant free text data field) for the patient were removed (245 of 27 041 records). When a student reported engaging twice with the same patient (same file number and date of birth) on the same date, the record was regarded as a duplicate submission and removed from the database before analysis (85 of 26 796 records). Finally, 319 records submitted by six students who did not complete clinical training in 2022 were removed. After cleaning, basic analysis was performed in Excel and Stata 18 software (Stata Corp., USA). Descriptive analysis was performed for the following variables: CLCs, consultation department, year of study, age of the patient, gender of the patient and student, and procedures. We report proportions, frequencies and graphic representations of the variables.

Ethical considerations

The Research Ethics Committee of the Faculty of Health Sciences at UP granted ethical approval for the study (ref. no. REC 56/2011). When collecting the data, the students did not include the names and surnames of the patients, but used initials. For anonymity, no patient-identifying information was presented. The Qualtrics data remain part of the UP database and are stored securely on the Qualtrics servers. The downloaded data are kept securely on two ClinA laptops, with restricted access (password protected).

Results

In 2022, 88 ClinA students in year 2 (n=46) and year 3 (n=42), who completed their full year of clinical training, logged 26 392 patients in 15 CLCs. The second-year students logged an average of 292 patients each (standard deviation (SD) 58.0) for the year (compared with n=320 expected), ranging from 149 to 395 patients per student. Third-year students logged an average of 309 patients each (SD 66.5) for the year (compared with n=340 expected), ranging from 97 to 441 patients per student.

The second-year students logged most patients in the 25 - 29-year age group, followed by the 30 - 34-year age group and the 35 - 40-year age group (Fig. 1A). The third-year students logged most patients in the 0 - 4-year age group, followed by the 30 - 34-year and 25 - 29-year age groups (Fig. 1B). Notably, second-year students logged fewer patients (5% of the total) in the under-5 age group than third-year students (13%) (Fig. 1A and B).

The second-year students logged the highest percentage of patients (n=2 429, 18%) during their musculoskeletal (MSK) theme. Similarly, most procedures were logged under the MSK theme (n=1 991, 17%). The genitourinary theme was the second most common, logging many patients (n=1 907, 14%) and procedures (n=1873, 16%). The respiratory theme was the third most common, with a high number of patients (n=1 882, 14%) and procedures (n=1 692, 14%) logged (Table 2).

When comparing the expected numbers of patients and procedures (calculated according to the time allocated to the specific theme) with the actual numbers logged by second-year students, we observed that the neurological and ear, nose and throat (ENT) themes were particularly under-represented in terms of patients and procedures logged. More than

Table 1. Profile of the hospitals where clinical associate students were allocated for their longitudinal integrated clerkship in 2022

Province	Facility	Facility type	Approved beds (beds in use), *n*	Student group size	
				2-nd year	3-rd year
Gauteng	Kalafong	Tertiary	1 113	-	7
	Mamelodi	Regional	337	6	7
	Pretoria-West	District	146	3	-
	Tembisa	Tertiary	840	8	6
Mpumalanga	Middelburg	District	249 (213)	-	5
	Rob Ferreira	Tertiary	350	-	3
	Shongwe	District	350 (175)	-	2
	KwaMhlanga	District	55 (66)	2	-
	Ermelo	District	264 (218)	4	-
	Mmametlhake	District	148 (66)	6	-
	Tonga	District	250 (152)	5	5
	Witbank	Tertiary	350 (382)	-	4
Kwa-Zulu Natal	GJ_Crooks	District	360	4	-
	Osindisweni	District	240	-	3
Limpopo	Seshego	District	175	8	-
Total				46	42

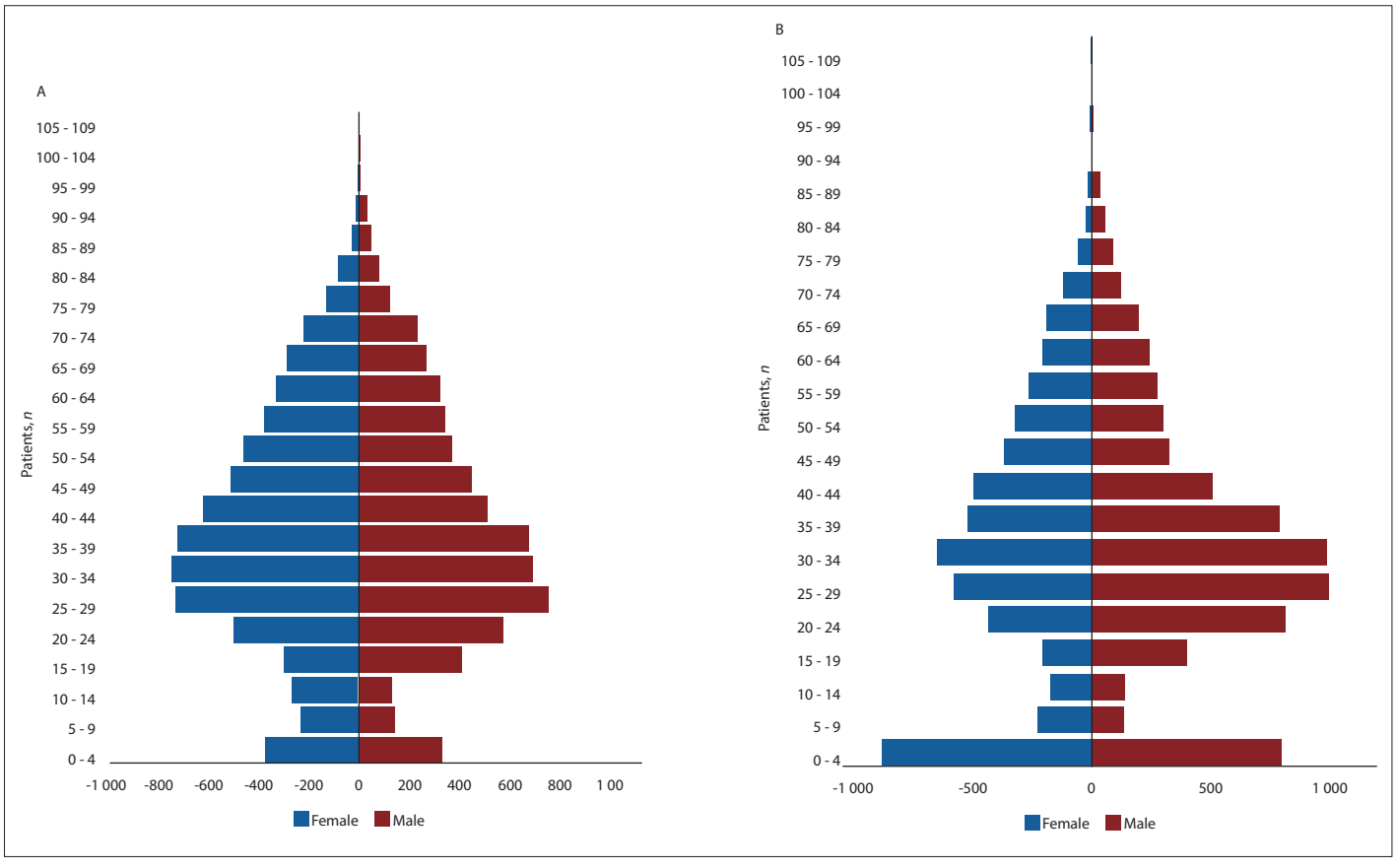

Fig. 1. Population pyramid of patients seen by Bachelor of Clinical Medical Practice second-year (A) and third-year (B) students in 2022.

the expected number of patients were logged in other themes and therefore the total was only 12 patients (0.1%) short of the expected number. In total, 4 248 (56%) more than the expected number of procedures were logged by second-year students, with extra procedures mostly being from the MSK, genitourinary and respiratory themes.

The third-year students logged the most patients under emergency medicine (*n*=3 663, 28%), followed by women's health (*n*=2 152, 17%). Similarly, 3 764 (30%) procedures were logged during emergency medicine. Furthermore, 2 433 (19%) procedures were logged under women's health (Table 2). Interestingly, few patients were logged during the anaesthesia rotation (*n*=688, 5%).

In the child health module, third-year students logged fewer than the expected number of patients and procedures. In the chronic and infectious disease module, an adequate number of patients were logged but far fewer than the number of expected procedures were recorded. In total, third-year students logged 1 316 (9%) fewer patients than expected and 3 979 (46%) more procedures than expected.

Students reported active involvement in the procedures they logged. They performed 74% of the procedures, assisted in 21% and observed 5%. The most common procedures were venepuncture and inserting intravenous lines. As described in Table 3, for the 10 most commonly reported procedures, only in the case of normal deliveries and lumbar punctures they assisted with more procedures than performing them.

When we compared the departments where the students logged the most patients, Fig. 2 shows that for both years, students logged the most patients in the emergency department (42%), followed by medical wards (13%). Third-year students logged 6% of their patients at a psychiatric healthcare service, whereas second-year students logged only 0.4% of their patients at such a service. Furthermore, only 3% of third-year students' patients were logged from clinics, whereas second-year students logged 8% from clinics.

As shown in Fig. 2A, second-year students logged most of their patients in the emergency department (47%). The percentages of patients in the outpatient department and medical ward were 21% and 14%, respectively. Fig. 2B shows that third-year students logged most patients in the emergency department (37%). The maternal health department, outpatient department, and medical wards accounted for 13%, 12% and 12% of the patients, respectively.

Even though all the records included a chief complaint and clinical assessment, these could not be analysed for this article because it was in free text format. However, as shown in Fig. 3, for 12 147 patients (46% of all patients logged), students selected at least one of 13 listed diagnoses. Of these, 26% of patients had HIV, 26% had hypertension, 18% suffered trauma, 17% were pregnant and 14% had diabetes mellitus.

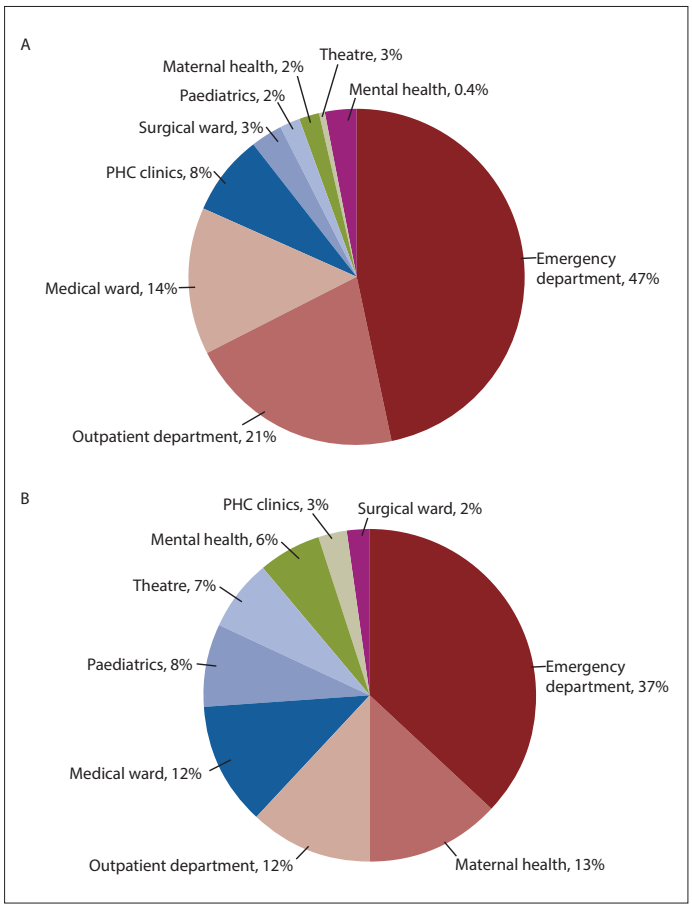

Fig. 2. Departments where second-year (A) and third-year (B) Bachelor of Clinical Medical Practice students logged patients in 2022. (PHC = primary healthcare.)

Discussion

In this retrospective review of e-logging data recorded by BCMP students at UP, we described the patients seen by second- and third-year ClinA students in 2022. Using e-logbooks has been shown to enhance real-time entry and reflection on procedures that the students performed.[19] The facilitators would check the reports of the logged data on a weekly basis, and if there were discrepancies, a student or preceptor would be requested to verify the information. Furthermore, the e-logbook facilitates communication with preceptors because, when students fall behind in meeting training requirements,[19] they need to submit a plan on how to address these. Moreover, as logged data are reported in real-time, mentors can easily track the progress of students and support them with their shortfalls to enhance their learning experiences. ClinA students who logged a smaller number of patients and did not report an adequate number of procedures, would be alerted on a weekly basis by mentors to support their progress.

In our study, students logged a comprehensive variety of patients, which we regarded as a measure that they were adequately exposed to, as the patients presented with various conditions. Although some of the themes should have had more exposure than what was observed, e.g. for the ENT theme in the second year, we expected that students would log more under-5 children, who often present with ENT conditions. However, the programme is organised in such a way that students do not engage much with under-5 children in their second year. Child health is a third-year module, and the second-year students might not have felt the need to see paediatric patients, as they are not assessed on these patients (according to behaviourist theory, a student will do something when there is a reward or a punishment attached).[20] There is, therefore, a need to ensure that the programme exposes students to paediatric patients, especially those under 5 years of age, before they reach their third year. This study further reports that the number of patients and procedures expected to have been logged by the students fell short in the case of the neurological theme and chronic disease module. The reasons for lower-than-expected patient numbers for the neurological theme, procedures logged for the chronic and infectious module and the overall low number of patients logged by third-year students need to be explored in future research.

Students also rotate in the emergency department, especially when they are on call (either on weekends or after work hours). The high number of patients seen there by ClinA students serves as an excellent training opportunity because in emergency departments of public health sector facilities students are exposed to several conditions, ranging from simple to complex cases. These departments offer ideal learning experiences for ClinA students, with the benefit of preparing them to relieve some of the workload in these environments, as demonstrated in a study done in the UK's National Health System in 2020. The said study[21] found that

physician associates (PAs) (ClinA counterparts in the UK) are able to treat patients with a range of conditions safely and deliver similar care to that provided by doctors in their second year of training. They concluded that deployment of PAs within emergency department teams is a potential solution to the situation of growing patient demand and predicted shortage of junior doctors.[21] A similar finding was reported in a US study, showing that PAs could function effectively in the emergency department. Furthermore, the impact of their work was appreciated by the patients.[22] Another study reported that PA students working in the emergency department had similar knowledge and competence compared with the medical students and worked amicably within the healthcare team.[23] Yet, this finding does not translate to replacing of either profession with the other. The need to ensure that students are well prepared in this department for future practice is inevitable. The LIC programme enhances the students' decision-making skills by exposing them to these high-stakes learning opportunities. Decision-making skills are crucial when students qualify because they have to think and act quickly when treating patients with emergency conditions.

As shown in Fig. 2, second-year students logged very few patients from the mental health, maternal health and paediatric areas of their CLCs, which is attributed to minimal exposure to these areas. However, in the third year more patients are logged from these areas, which ensures that ClinA students are comprehensively trained before graduating. However, there is a need for early exposure so that they can build on the competencies learnt in their second year. Studies have shown that exposing students earlier is beneficial, as it improves skills, attitude and confidence in patient-related healthcare.[16,24,25]

The third-year students saw very few patients in public healthcare (PHC) clinics owing to limited time spent there. This is mostly due to lack of transport to clinics. Second-year students logged more patients from clinics because during their 3-week elective period they worked full time in a PHC facility of their own choice and arranged their own transport and accommodation.

ClinA students selected clinical diagnoses for some of their logged patients. The reasons for not selecting such diagnoses for all their patients may be twofold. Firstly, many patients may not have had - or did not disclose - that they had one of the 13 listed diagnoses. Secondly, it may also be that the students opted to skip the specific question in the survey. The diagnoses that students selected (Fig. 3) are similar to those seen in SA's primary healthcare,[26] as communicable diseases, non-communicable diseases, maternal and child diseases, as well as trauma, constitute the quadruple burden of disease in SA.[27,28] SA reports a high burden of trauma, ranging from unintentional injuries to motor vehicle accidents to gender-based violence.[29] This correlates with the many trauma patients ClinA students see in the emergency department.[29] Unfortunately, the students were not required to state the type of trauma on the drop-down selection of diagnoses, which would have shed light on prevalent traumas in these CLCs. SA has seen a shift in non-communicable diseases due to several factors such as sedentary lifestyles and poor nutritional choices, which have contributed to a high prevalence of hypertension, type 2 diabetes and other non-communicable diseases.[30] Students, through e-logbook data in the LIC, demonstrated experiencing their engagement in the management of the SA quadruple burden of disease, which forms an authentic learning exposure in the LIC. Additionally, students rotated at hospitals and clinics, which meant that they engaged with disease profiles at different stages - from acute to chronic - in various levels of the healthcare system.

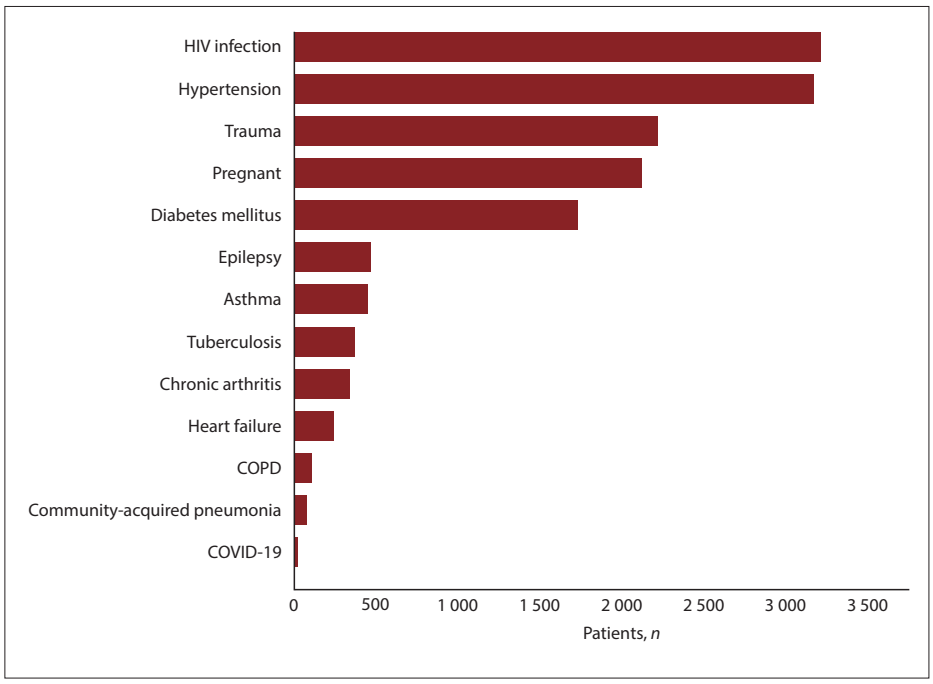

Fig. 3. Selected diagnoses logged by the students during the longitudinal integrated clerkship period in 2022. (Trauma = injury in the past 72 hours; chronic arthritis = osteoarthritis, rheumatoid arthritis, gout and others; COPD = chronic obstructive pulmonary disease.)

Third-year ClinA students engage with the full spectrum of healthcare challenges by having designated rotations and training time in disciplines such as emergency medicine, women's health and child health. They are prepared to manage the same variety of medical conditions they will encounter in their future careers. Some studies have reported that students appreciate LIC training, as they take an active role in patient care and gain greater insight into patients' illnesses and healthcare services.[31] However, keeping track of student-patient interactions during the learning process is important so that educators can monitor students' academic progress, provide formative feedback, conduct quality assurance checks (such as verifying adherence to guidelines) and ensure patient safety. The e-logbook then becomes a valuable tool for monitoring the learning environment.

This study also investigated the procedures that students could perform independently or with assistance from qualified healthcare workers, or merely by observing. The data indicated that students performed a large number of circulatory access procedures and electrocardiograms (ECGs). Compared with a study where medical students were not comfortable performing venepuncture,[32] our ClinA students frequently performed this procedure, obtained intravenous access, and performed ECG and arterial blood gas measurements on patients. Normal deliveries and lumbar punctures are lower down on the top

Table 2. Patients and procedures logged by BCMP students per study theme or discipline

Second year, themes (weeks)	Expected patients, *n* (%)	Actual patients, *n* (%)	Expected procedures, *n* (%)	Actual procedures, *n* (%)
Respiratory (3)	1 260 (9)	1 882 (14)	709 (9)	1 692 (14)
Cardiovascular (3)	1 260 (9)	827 (6)	709 (9)	624 (5)
Gastrointestinal (3)	1 260 (9)	1 296 (10)	709 (9)	1 142 (10)
Genitourinary (3)	1 260 (9)	1 907 (14)	709 (9)	1 873 (16)
Neurological (4.9)	2 068 (15)	1 263 (9)	1 163 (15)	1 043 (9)
Musculoskeletal (3.7)	1 545 (11)	2 429 (18)	869 (11)	1 991 (17)
Dermatology (3.7)	1 545 (11)	1 396 (10)	869 (11)	1 353 (11)
Endocrinology (1.5)	630 (5)	807 (6)	354 (5)	681 (6)
Reticuloendothelial (including malaria) (1.5)	630 (5)	404 (3)	354 (5)	416 (4)
Ear, nose and throat (2.4)	1 020 (8)	274 (2)	641 (8)	158 (1)
Ophthalmology (1.25)	540 (4)	240 (2)	321 (4)	209 (2)
HIV (1)	420 (3)	703 (5)	236 (3)	626 (5)
Total	13 440 (100)	13 428 (100)	7 560 (100)	11 808 (100)
Third year, disciplines (weeks*)	**Expected patients, *n* (%)**	**Actual patients, *n* (%)**	**Expected procedures, *n* (%)**	**Actual procedures, *n* (%)**
Women's health (6)	1 800 (13)	2 152 (17)	1 085 (13)	2 433 (19)
Child health (7)	2 100 (15)	1 581 (12)	1 266 (15)	1 342 (11)
Emergency medicine (272 hours)	4 080 (29)	3 663 (28)	2 460 (29)	3 764 (30)
Chronic and infectious diseases (11)	3 300 (23)	2 848 (22)	1 990 (23)	2 343 (19)
Anaesthesia (3)	900 (6)	688 (5)	543 (6)	1 054 (8)
Mental health (4)	1 200 (8)	909 (7)	724 (8)	585 (5)
Orthopaedics (3)	900 (6)	1 123 (9)	543 (6)	1 068 (8)
Total	14 280 (100)	12 964 (100)	8 610 (100)	12 589 (100)

BCMP = Bachelor of Clinical Medical Practice.
*Unless otherwise indicated.

Table 3. The 10 most common procedures reported by BCMP students during their longitudinal integrated clerkship involvement

Procedure	Total, *n*	Performed, %	Assisted, %	Observed, %
Venepuncture*	5 014	92	6	2
Intravenous lines*	2 659	91	8	1
Intramuscular injection*	957	90	4	6
Suture lacerations	903	89	9	2
Arterial blood gas*	540	95	3	2
Blood transfusion	505	59	34	7
Normal vagina delivery	427	35	57	8
Apply back slab (arm)	366	71	28	1
Obtain an electrocardiogram	364	91	9	0
Lumbar puncture (adults)	330	44	48	8

BCMP = Bachelor of Clinical Medical Practice.
*Circulatory access.

10 list; third-year students, but not second-year students, are required to perform normal deliveries during their women's health module. However, this finding warrants further investigation. Both second- and third-year ClinA students are required to perform lumbar punctures under the neurology theme (second year) or during the anaesthesia and the chronic/infectious modules (third year). Nevertheless, they assisted more frequently than observing or performing the procedures independently. It can be hypothesised that as these procedures are more invasive or critical, students may be hesitant to perform them due to fear,[33] or preceptors may not have permitted them to perform the procedures due to lack of competence. However, an in-depth interview would be necessary to explore the underlying causes.

Study limitations

This study had few limitations. Firstly, it did not authenticate all the patients logged by the students, which may introduce reporting bias. Secondly, students were allocated to one site for the entire year, which could have affected their level of exposure if the relevant CLC had a low patient load. Lastly, students were not necessarily allocated according to their language proficiency, which could negatively have impacted the number of patients they consulted and logged if there was a language barrier.

Conclusion

Our findings show that UP ClinA students were exposed to a variety of patients and procedures within the LIC model as evidenced by the

entries of the e-logbook data. This exposure should prepare the students to function as effective clinicians in teams in the SA healthcare system. The emergency department emerged as the area that offers the students the most opportunities for authentic learning due to the high volume of patients logged by all the students, making it an essential rotation for ClinA student training. The clinical experiences of ClinA students can be monitored in e-logbooks to inform adjustments to ensure a well-balanced, comprehensive, authentic curriculum. Further research is needed to establish the minimum number of patient encounters required to ensure that students are competent in diagnosing and managing patients with specific presentations and diagnoses.

Data availability. The data sets generated and/or analysed during the current study are available from the corresponding author upon reasonable request.

Declaration. None.

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