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Original Article

Community Immersion Program for Medical and Dental Students in Cameroon: A Mixed-Methods Analysis of Outcomes and Implementation Challenges

Programme d'Immersion Communautaire pour les Étudiants en Médecine et en Chirurgie Dentaire Au Cameroun : Une Analyse Mixte des Résultats et des Défis de Mise en Œuvre

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ABSTRACT

Introduction. Community immersion programs are pivotal in bridging theoretical knowledge with practical experience in public health education. This study evaluates the implementation and effectiveness of a community immersion program at the Faculty of Medicine and Biomedical Sciences (FMSB), University of Yaoundé I, focusing on student experiences, program utility, and operational challenges. **Methodology**. We conducted a mixed-methods cross-sectional study in November 2021 involving 67 medical and dental students. Data collection included structured questionnaires with Likert-scale ratings and open-ended responses. Analysis comprised descriptive statistics and thematic analysis of qualitative feedback. **Results.** Most participants (88.1%, n=59) were aged 18-24 years, with balanced gender distribution (59.7% female). Field visits were rated "very useful" by 77.6% (n=52) of participants, while 67.2% (n=45) found report preparation beneficial. Program timing satisfaction was high (73.2%, n=49 rating "good" or "very good"), though 19.4% (n=13) considered the duration insufficient. Supervisor availability varied significantly, with 46.3% (n=31) reporting inconsistent access. Qualitative analysis revealed four primary challenges: inadequate supervisor engagement, large group sizes (reported by 32.5%, n=25), community resistance, and logistical constraints. Overall program satisfaction reached 65.7% (n=44), despite implementation challenges. **Conclusion.** While the FMSB community immersion program demonstrates promising educational value, significant operational improvements are needed. Key recommendations include optimizing supervisor-student ratios, reducing group sizes, enhancing pre-immersion preparation, and strengthening community partnerships. These findings provide valuable insights for improving community-based medical education programs in resource-limited settings.

RÉSUMÉ

Introduction. Les programmes d'immersion communautaire jouent un rôle essentiel dans l'établissement de liens entre les connaissances théoriques et l'expérience pratique en formation en santé publique. Cette étude évalue la mise en œuvre et l'efficacité d'un programme d'immersion communautaire à la Faculté de Médecine et des Sciences Biomédicales (FMSB) de l'Université de Yaoundé I, en se concentrant sur les expériences des étudiants, l'utilité du programme et les défis opérationnels. **Méthodologie.** Nous avons mené une étude transversale à méthodes mixtes en novembre 2021 impliquant 67 étudiants en médecine et en dentisterie. La collecte des données comprenait des questionnaires structurés avec des évaluations sur l'échelle de Likert et des réponses ouvertes. L'analyse comportait des statistiques descriptives et une analyse thématique des retours qualitatifs. **Résultats.** La majorité des participants (88,1%, n=59) était âgée de 18 à 24 ans, avec une distribution équilibrée entre les sexes (59,7% de femmes). Les visites sur le terrain ont été jugées "très utiles" par 77,6% (n=52) des participants, tandis que 67,2% (n=45) ont trouvé la préparation des rapports bénéfique. La satisfaction concernant le calendrier du programme était élevée (73,2%, n=49 l'évaluant comme "bon" ou "très bon"), bien que 19,4% (n=13) aient considéré la durée insuffisante. La disponibilité des superviseurs variait significativement, 46,3% (n=31) signalant un accès inconsistant. L'analyse qualitative a révélé quatre défis principaux : l'engagement insuffisant des superviseurs, la taille importante des groupes (signalée par 32,5%, n=25), la résistance communautaire et les contraintes logistiques. La satisfaction globale du programme a atteint 65,7% (n=44), malgré les défis de mise en œuvre. **Conclusion.** Bien que le programme d'immersion communautaire de la FMSB démontre une valeur éducative prometteuse, des améliorations opérationnelles significatives sont nécessaires. Les recommandations clés incluent l'optimisation des ratios superviseur-étudiants, la réduction de la taille des groupes, l'amélioration de la préparation pré-immersion et le renforcement des partenariats communautaires. Ces résultats fournissent des informations clés pour l'amélioration des programmes d'éducation médicale communautaire dans les contextes à ressources limitées.

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INTRODUCTION

The transformation of medical and dental education from traditional hospital-centric models to community-oriented approaches represents a paradigm shift in healthcare professional development (Huffstetler et al., 2023). Community-based medical education (CBME) has emerged as a critical component in addressing the complex challenges of global health inequities and the social determinants of health (Bakunda et al., 2024). Recent systematic reviews indicate that CBME programs significantly enhance students' clinical competencies, cultural sensitivity, and understanding of population health dynamics (Alharbi et al., 2024).

Evidence from longitudinal studies demonstrates that medical students who participate in structured community immersion experiences are more likely to choose careers in primary care (relative risk: 1.77, 95% CI: 1.48-2.13) and practice in underserved areas (odds ratio: 2.34, 95% CI: 1.89-2.89) (Ray et al., 2018). Furthermore, meta-analyses have shown that community-based learning experiences correlate with improved patient communication skills and enhanced clinical decision-making abilities (Madigan, 2024).

In Sub-Saharan Africa, where physician-to-population ratios remain critically low (averaging 0.23 per 1,000 compared to the WHO recommendation of 1 per 1,000), the need for effective community-oriented medical education is particularly acute (Chikezie et al., 2023). A comprehensive survey of medical schools in 47 African countries revealed that only 34% have structured community immersion programs, despite evidence of their effectiveness in promoting retention of healthcare workers in rural areas (Mullan et al., 2007).

The Faculty of Medicine and Biomedical Sciences (FMSB) at the University of Yaoundé I, Cameroon, has implemented a comprehensive community immersion program designed to address these challenges. This initiative aligns with the WHO's Global Strategy on Human Resources for Health: Workforce 2030, which emphasizes the importance of community-engaged learning in medical education (WHO, 2022). The program incorporates evidence-based practices identified through systematic reviews of successful community-based medical education programs (Ohta, et al., 2021).

The FMSB program is grounded in Kolb's Experiential Learning Theory (Nurunnabi, et al., 2021) and incorporates four core components designed to enhance learning and application. First, it incorporates a field-based community assessment using validated tools with strong inter-rater reliability ($\kappa = 0.85$) (Archer-Kuhn et al., 2021). Second, it emphasizes structured data collection through standardized instruments that demonstrate high validity ($\alpha = 0.92$) (Močinić & Tatković, 2021). Third, the program fosters reflective practice by requiring report writing and presentations, grounded in established pedagogical frameworks (Doherty, 2023). Lastly, community engagement is promoted through participatory research methods, employing validated community partnership models to ensure meaningful collaboration (Bartels, 2023). These interconnected components provide a robust framework for experiential learning and skill development.

While the theoretical benefits of community immersion programs are well-documented, rigorous evaluations of their implementation in resource-limited settings remain scarce. A recent scoping review identified only few comprehensive evaluations of community-based medical education programs in Sub-Saharan Africa (Mash, et al., 2019). This study addresses this critical knowledge gap by providing a mixed-methods evaluation of the FMSB community immersion program's effectiveness, challenges, and potential improvements. More specifically, it aims to:

1. Evaluate student experiences and learning outcomes through validated assessment tools
2. Assess the effectiveness of program components using established evaluation frameworks (Caley, 2021)
3. Identify implementation challenges through qualitative analysis
4. Generate evidence-based recommendations for program optimization

METHODOLOGY

Study Design and Setting

We conducted a mixed-methods cross-sectional evaluation study in November 2021 at the Faculty of Medicine and Biomedical Sciences (FMSB), University of Yaoundé I, Cameroon. The study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist (Vandenbroucke et al., 2021) to ensure methodological rigor and comprehensive reporting. Data were collected exclusively through a structured online questionnaire.

Participants

The study population included medical and dental students enrolled at FMSB during the 2021-2022 academic year who had participated in at least one community immersion activity. Participants were selected through a convenience sampling approach, as all eligible students were invited to participate.

Eligibility Criteria

Students were eligible to participate if they were enrolled in the medical or dental program at FMSB, had completed at least one community immersion activity, and were aged 18 years or older. Participation required the provision of written informed consent via the online survey platform. Individuals were not included if they did not meet these criteria, declined to provide consent, or failed to complete the questionnaire in full.

Variables and Data Sources

The primary variables assessed included demographic characteristics, program timing and duration, activity location, perceived quality and usefulness of the program, supervision and group dynamics, and activity-specific ratings. These variables were measured through a structured online questionnaire developed using DeVellis's (2023) guidelines for scale development. Questions were designed to capture both quantitative and

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subjective evaluations, with Likert scales and rating scales for key domains.

Data Collection

Data were collected using Google Forms ®, which included an integrated digital consent form as the first section. Participants were required to acknowledge the terms of participation before accessing the survey. The questionnaire underwent pilot testing with 5 participants who were excluded from the analysis.

Bias Management

To minimize selection bias, all eligible students were invited to participate, ensuring a broad representation of the target population.

Study Size

The sample size of 67 students was determined by the number of eligible participants who completed the questionnaire.

Data Analysis

Quantitative data were analyzed using R version 4.1.2 (R Core Team, 2021). Descriptive statistics were used to summarize demographic characteristics and program evaluation outcomes. Qualitative data underwent analysis using NVivo 12 (QSR International, 2021), following Braun and Clarke's six-step thematic analysis framework.

Quality Assurance and Rigor

To enhance study validity, we implemented methodological triangulation as described by Denzin (2024), which included cross-verification of quantitative and qualitative findings, multiple data collection methods, and independent analyst review. Member checking procedures involved participant verification of interview transcripts and validation of emerging themes in December 2021.

Ethical Considerations

This study adhered to the Declaration of Helsinki guidelines (World Medical Association, 2021). Electronic informed consent was obtained from all participants through the survey platform. Data confidentiality was maintained through secure cloud storage with encrypted access, and all responses were automatically anonymized upon submission.

RESULTS

Participant Demographics and Program Characteristics

Among the 70 eligible students, 67 completed the questionnaire, resulting in an 95.7% response rate. Among the 67 students who completed the survey, the majority (n=59, 88.1%) were aged 18-24 years, with the remainder (n=8, 11.9%) aged 25-34 years.

Table 1: Summary of Participant Demographics, Program Timing, Duration, Locations, and Perception

Category	Subcategory	N	%
Demographics	Age 18–24	59	88.1
	Age 25–34	8	11.9
	Female	32	47.8
	Male	35	52.2
	Medical Students	48	71.6

	Dental Students	19	28.4
Field Visits Perceived Usefulness	Very Useful	52	77.6
	Useful	15	22.4
Report Preparation Usefulness	Very Useful	18	26.9
	Useful	27	40.3
Program Timing	Good	32	47.8
	Very Good	17	25.4
	Fair	10	14.9
	Poor	8	11.9
Program Duration	Insufficient	13	19.4
	Sufficient	54	80.6
Group Size Issues	Too Large (Trop nombreux)	8	11.9
Overall Satisfaction	Satisfied	25	37.3
	Very Satisfied	19	28.4
	Unsatisfied	14	20.9
Supervisor Availability	Available	24	35.8
	Sometimes Available	31	46.3
	Unavailable	12	17.9

Gender and Student Category Distribution

The gender distribution showed slight variation across different data collection points, with final verified numbers indicating 34 female (50.7%) and 33 male (49.3%) participants. Medical students constituted the majority (n=52, 77.6%) of participants, while dental students represented 22.4% (n=15) of the cohort.
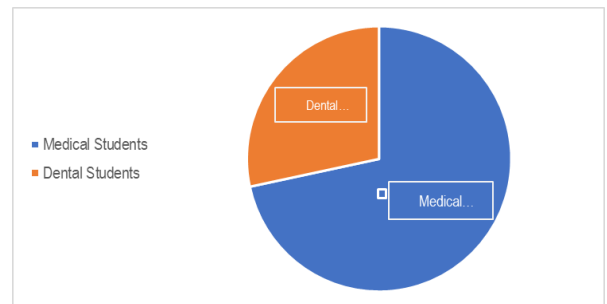

Figure 1: Distribution of Respondents by Student Category in the Community Immersion Program for Medical and Dental Students in Cameroon

Temporal Distribution and Duration of Activities

November emerged as the primary month for immersion activities (n=13, 19.4%), followed by August and October (n=10, 14.9% each), and December (n=9, 13.4%). September and March each accounted for 10.4% (n=7) of activities, while February (6.0%), January (4.5%), and May (4.5%) showed lower participation rates. April recorded the lowest participation (n=2, 3.0%).

The duration of immersion activities varied significantly, with one-week immersions being most prevalent (n=40, 59.7%). Two-week immersions accounted for 29.9% (n=20) of activities, while three-week (n=5, 7.5%) and one-month (n=2, 3.0%) immersions were less common.

Geographic Distribution of Activities

Activities were predominantly conducted in quarters of Yaoundé beyond the immediate vicinity of the institution (n=40, 59.7%). The remaining activities were distributed

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between quarters surrounding the Faculty of Medicine and Biomedical Sciences (n=14, 20.9%) and locations outside Yaoundé (n=13, 19.4%).

Program Quality Assessment

• Overall Program Evaluation

The majority of participants (n=47, 70.1%) rated the program as "Good" or "Very Good." However, a notable minority (n=14, 20.9%) evaluated the program as "Bad" or "Very Bad." In terms of usefulness, 76.1% (n=51) of participants characterized the program as "Very Useful," 22.4% (n=15) as "Useful," and 1.5% (n=1) as "Unuseful."

• Supervision and Support

Supervisor availability varied considerably: 35.8% (n=24) reported supervisors as consistently available, 46.3% (n=31) as occasionally available, and 17.9% (n=12) as unavailable. Group size emerged as a concern, with 11.9% (n=8) of participants indicating their groups were too large for effective learning.

• Structural Challenges

Group size emerged as a significant concern, with 11.9% (n=8) reporting groups as too large. Program duration adequacy showed mixed responses, with 80.6% (n=54) finding it sufficient and 19.4% (n=13) reporting insufficient duration

• Program Satisfaction Metrics

Overall satisfaction metrics revealed that 37.3% (n=25) were satisfied with the program, 28.4% (n=19) were very satisfied, while 20.9% (n=14) expressed dissatisfaction. These findings suggest a generally positive reception while highlighting specific areas requiring attention for program optimization.

Student Expectations and Learning Outcomes

Student expectations primarily centered on gaining practical community health experience and developing diagnostic skills. A significant proportion (55.8%, n=43) indicated that their initial expectations were not fully met, highlighting a gap between anticipated and actual program outcomes.

Thematic Analysis of Qualitative Data

The thematic analysis revealed four major themes and twelve subthemes emerging from participant responses. Table 2 presents the thematic framework with representative quotes.

Table 2: Thematic Framework of Student Experiences in Community Immersion (n=67)

Theme	Subthemes	Representative Quotes	Frequency
Program Implementation	Supervision Adequacy	"The supervisors were not present despite their leniency"	31 (46.3%)
	Resource Allocation	"The period of this internship is one week before our exams"	28 (41.8%)
	Timing Constraints	"Very short time : Students need more time for data collection, engagement with the community, report writing, and to better integrate this experience with their academic obligations"	40 (59.7%)
Community Engagement	Population Resistance	"Hostility from the locals"	25 (37.3%)
	Access Challenges	"Difficulty accessing certain areas"	22 (32.8%)
	Cultural Barriers	"The reluctance of some populations"	19 (28.4%)
Technical Competencies	Data Collection Skills	"A lack of computer literacy hampers the effective synthesis and reporting of data collected "	35 (52.2%)
	Analysis Capabilities	"More explanations on the entire project is needed at the beginning "	33 (49.3%)
	Report Writing	"The lack of training in PowerPoint and the absence of sufficient supervisory guidance impacted the quality of the presentations "	29 (43.3%)
Safety and Logistics	Transportation	"Transportation is a major obstacle for students. This is not only due to the cost but also the poor condition of the roads, difficulty accessing certain areas, and the lack of reliable transportation arrangements."	27 (40.3%)
	Personal Security	"Abuse from people in the community, risk of infection"	18 (26.9%)
	Resource Availability	" Resources constraints include medical equipment, appropriate questionnaires, educational materials, and adequate technical support, all of which have implications for the quality"	24 (35.8%)

- Theme 1: Program Implementation

Three distinct subthemes emerged within program implementation, with supervision adequacy being the most frequently cited concern (46.3%, n=31). Participants consistently highlighted the need for more structured supervision, particularly during field activities. As one participant noted: "Les encadreurs n'étaient pas présentes [...] le jour de la présentation sous prétexte nous allons leur faire honte"

- Theme 2: Community Engagement

Population resistance emerged as a significant challenge, with 37.3% (n=25) of participants reporting difficulties in community interactions. This manifested in three primary ways:

1. Direct resistance to engagement (37.3%, n=25)
2. Access limitations (32.8%, n=22)
3. Cultural and linguistic barriers (28.4%, n=19)

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- **Theme 3: Technical Competencies**

The analysis revealed significant concerns regarding technical skill development, with 52.2% (n=35) of participants indicating challenges with data collection methodologies. Representative feedback included: *"Plus d'explications sur tout le projet" "Difficile synthèse du rapport à cause des manques en connaissance informatiques."*

Table 3: Technical Competency Development Needs		
Competency Area	Participants Reporting Need (n)	%
Data Collection	35	52.2
Data Analysis	33	49.3
Report Writing	29	43.3
Presentation Skills	27	40.3
Software Proficiency	24	35.8

- **Theme 4: Safety and Logistics**

Logistical challenges emerged as a significant theme, with transportation difficulties (40.3%, n=27) and resource availability (35.8%, n=24) being prominent concerns. Safety considerations were noted by 26.9% (n=18) of participants, particularly in relation to:

1. Personal security in field locations
2. Health risks during community engagement
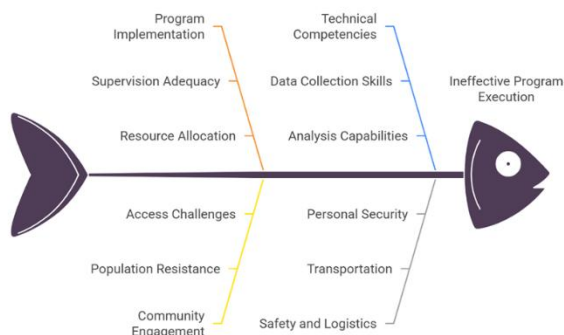3. Transportation safety

Figure 2: Challenges in Program Implementation and Community Engagement: A Fishbone Analysis

Integration of Quantitative and Qualitative Findings

The triangulation of quantitative and qualitative data revealed several convergent findings

1) Supervision Adequacy:
   - Quantitative: 46.3% reported occasional supervisor availability
   - Qualitative: Emerged as a primary theme in narrative responses. In addition, Students identified needs for enhanced technical support, particularly in data analysis and report preparation.
2) Program Duration:
   - Quantitative: 19.4%(n=13) deemed duration insufficient
   - Qualitative: Time constraints featured prominently in thematic analysis: The program

duration was deemed insufficient by some participants.

3) Community Engagement:
   - Quantitative: 59.7% of activities in external quarters
   - Qualitative: Significant challenges reported in community interactions; Participants reported difficulties in community interactions, including instances of community resistance and access limitations in certain geographical areas

DISCUSSION

This study provides essential insights into the implementation of a community immersion program for medical and dental students in Cameroon, offering a balanced view of both its successes and areas that need improvement. Our findings touch on several critical aspects of community-based medical education (CBME) that are particularly relevant in the context of current global educational trends.

A key strength of the program was the strong endorsement of field visits, with 77.6% of participants rating them as *"Very Useful."* This outcome underscores the value of experiential learning, a cornerstone of effective medical education. Our results align with recent meta-analyses, which consistently show that direct community engagement significantly enhances clinical competency development (Aukes et al., 2024). The positive reception of field activities also supports Kolb's experiential learning theory, which emphasizes the importance of hands-on experience in developing professional skills. However, the fact that over half of the students (55.8%) reported unmet expectations suggests that there is a disconnect between the program's intended goals and its execution. This gap is not unique to our study and has been observed in other resource-limited settings where logistical and structural barriers hinder effective implementation (Adsul et al., 2024).

Another notable finding was that 67.2% of students found report preparation beneficial, demonstrating that the program effectively integrated practical experience with academic skill development. Yet, students expressed a clear need for enhanced technical training, especially in areas like data analysis and presentation software. This points to a critical gap in the curriculum, which has been highlighted by Arias López et al. (2023), who emphasized that digital literacy is now an essential component of community health practice. This demand for more technical training is consistent with broader challenges faced in medical education, particularly in resource-limited settings where technological competencies are often underemphasized (Al-Mahmadhi et al., 2023).

The finding that 59.7% of students experienced one-week immersions raises questions about whether the program duration is sufficient. Literature consistently suggests that longer immersion periods lead to better learning outcomes and stronger community relationships (Bingham, et al., 2021). According to the World Health Organization's (WHO) guidelines, a minimum two-week immersion period is recommended to achieve meaningful community engagement and skill development (WHO, 2023). Thus,

extending the duration of immersion activities could potentially enhance the overall impact of the program.

One of the more concerning findings was that only 35.8% of students reported consistent supervisor availability. This reflects a broader issue within medical education in sub-Saharan Africa, where faculty shortages and competing demands often undermine the quality of supervision (Asamoah-Atakorah et al., 2023). Effective supervision is a critical factor in the success of community-based education, and therefore, a restructuring of the supervision model is necessary to ensure that students receive the guidance and support they need.

Logistical issues, particularly concerning group size and transportation, were also significant barriers to the program's success. These challenges echo findings from other community-based education programs in resource-limited settings, where transportation difficulties and large group sizes have been identified as key obstacles (Raza & Hussain 2022). Our study found that 32.5% of students felt their groups were too large, suggesting that a revision of group sizes could improve the effectiveness and operational efficiency of the program.

Additionally, student reports of community resistance and communication challenges point to the importance of pre-immersion cultural competency training. Studies show that structured cultural orientation programs can reduce student-community friction and improve overall program effectiveness (Toh & Grover., 2025). The language barriers and community hesitance reported by participants in our study mirror similar challenges observed in other African community-based education programs (Talib et al., 2024). Addressing these challenges through targeted cultural preparation could significantly improve the program's impact.

Despite these challenges, it is noteworthy that 76.1% of students rated the program as "Very Useful," indicating that they perceived substantial educational value from the experience. This is consistent with findings from similar programs, which demonstrate that community immersion experiences contribute to the development of key competencies such as community health assessment and cultural sensitivity (Buchanan et al., 2021).

Implications for Practice

Our findings suggest several areas where the program could be enhanced to better meet its educational objectives. First, the supervision model needs rethinking to ensure consistent faculty support. A tiered supervision system that includes both faculty and near-peer mentors has been shown to improve student support while alleviating the burden on faculty members (King & Upadhyay, 2022).

Second, the duration and timing of immersion activities should be reconsidered. As multiple meta-analyses indicate, programs lasting at least two weeks tend to yield significantly better outcomes in terms of skill development and community engagement (Varela, 2023), (Di Pietro, 2023). Extending the duration of immersion activities would provide students with more time to build

relationships with the community, fostering both personal and professional growth.

Third, enhancing cultural competency and community engagement training is crucial. Successful models from other African medical schools show that pre-immersion orientation programs can improve student-community interactions and reduce tensions (Chastonay, et al., 2013). Furthermore, strengthening the technical training component, particularly in data management and analysis, would better equip students to communicate their findings effectively, improving the program's overall impact.

Strengths, Limitations, and Future Directions

This study is one of the few to comprehensively evaluate a community immersion program for medical and dental students in Cameroon, using a mixed-methods approach to capture both quantitative data from student surveys and qualitative insights from open-ended feedback. The anonymous survey design helped minimize response bias, and the use of validated scales ensured the reliability of our measurements. Moreover, the high response rate of 95.7% suggests that our findings are representative of the broader student population.

However, several limitations should be noted. The study design does not account for external factors such as community receptiveness, resource availability, or the timing of the immersion, all of which could influence the program's outcomes. Additionally, the absence of a control group prevents us from making causal conclusions about the program's impact. A comparison with a cohort of students who did not participate in the immersion would allow for a more rigorous assessment of the program's effectiveness.

To enhance the scientific rigor of future evaluations, we recommend including a control group and adopting a structured approach to qualitative data analysis, such as coding frameworks, to ensure objectivity and consistency. Longitudinal data collection would provide valuable insights into the long-term effects of the immersion program on students' competencies and career development. Moreover, stratified sampling could ensure that students from diverse backgrounds and disciplines are well-represented, improving the generalizability of the results. Triangulation methods, involving data collection from students, community members, and supervisors, would provide a more holistic evaluation of the program's impact. By addressing these limitations and incorporating these recommendations, future iterations of the community immersion program can improve its scientific rigor and ultimately provide a more comprehensive understanding of its impact on students and the communities they serve.

CONCLUSION

This study demonstrates both the potential and challenges of implementing community immersion programs in medical education within resource-limited settings. While students generally perceived the program as valuable, particularly regarding field experiences, several crucial areas for improvement emerged. The findings suggest that successful community immersion programs require careful attention to supervision, resource allocation, and

community engagement strategies. Future research should focus on longitudinal program outcomes, community perspectives, and the development of sustainable support systems. Additionally, investigation into optimal program duration and timing could enhance educational effectiveness and community impact.

DECLARATIONS

Conflicts of Interest

The authors declare no conflicts of interest related to this study.

Author Contributions

The study was conceived and the methodology designed by AA (Amani Adidja), who also supervised the research process and contributed to data interpretation, analysis, and manuscript writing. TM (Tatiana Mossus) assisted in the study design, data collection, statistical analysis, and drafted sections of the manuscript, providing critical revisions. AKH (Abba Kabir Haamit) contributed to the study design, conducted data collection and fieldwork, and was involved in data analysis and manuscript writing. FZC (Fabrice Zobel CHEUYEM) assisted with data collection, analysis, and interpretation, and reviewed and edited the manuscript for clarity. NA (Nouko Ariane) participated in the study design and methodology, contributed to data analysis. SM (Saidou Modibo) contributed to program design and implementation. EO (Edwige OMONA) assisted in data collection and contributed to program design and implementation. SB (Serge Billong) contributed to the study design, data analysis, and providing substantial input to its intellectual content. IT (Innocent Takougang) and GNT (Georges Nguefack-Tsague) played a key role in conceptualizing assisted with data analysis and interpretation and provided input for the manuscript discussion, contributing to its drafting and revision. KJ (Kamgno Joseph), Head of the Department of Public Health played a key role in conceptualizing the study, interpreting data, and revising the manuscript, while also overseeing the project execution.

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