Available on: https://jnsrr.ep-journals.org/ E-ISSN: 3051-3766 P-ISSN: 3051-3758

Journal of Natural Science Research and Review

Volume: 01 Issue: 06 December-2025

Assessing Determinants of Knowledge Regarding Viral Hemorrhagic Fevers among Health Science Students in Rwanda: Implications for Public Health Preparedness

***Simon Pierre Ndayishimye Mvuyekure**
Africa Health Science University, Rwanda

Aime Fidele Ndayiragije Mvuyekure
Adventist University of the Philippines, Philippines

Josiane Niyonkuru
University of Kigali, Rwanda

Dushimumuremyi Jonathan
Institut Catholique de Kabgayi (ICK), Rwanda

Nyirandegeye Jacqueline
East African Christian College, Rwanda

Published Date: December 15, 2025 **Article DOI: 10.65150/EP-jnsrr/V1E6/2025-06**

ABSTRACT

Background: Viral Hemorrhagic Fevers (VHFs) remain among the most lethal infectious diseases globally, requiring well-prepared frontline health professionals capable of early detection, prevention, and outbreak response. In Rwanda, where Ebola, Marburg, and Rift Valley Fever remain periodic threats, understanding the determinants of VHF-related knowledge among future healthcare providers is essential for strengthening national public health preparedness.

Objective: This study assessed the extent to which academic level, exposure to infectious disease training, and access to health information resources influence knowledge regarding VHFs among health science students in Rwandan universities.

Methods: A quantitative, cross-sectional design was conducted among 180 students selected through stratified random sampling from the University of Gitwe, Institut Catholique de Kabgayi, and East African Christian College. Data were collected using a validated, self-administered questionnaire (Cronbach's $\alpha = 0.78–0.89$) and analyzed in SPSS 25 using descriptive statistics, Spearman correlation, and multiple linear regression at a 0.05 significance level.

Results: Students reported high perceived influence of academic level (grand mean = 3.131), infectious disease training exposure (grand mean = 2.999), and access to health information resources (grand mean = 2.947) on their VHF knowledge. Correlation analysis indicated significant positive relationships between VHF knowledge and academic level ($\rho = 0.661$, $p < 0.001$), exposure to infectious disease training ($\rho = 0.766$, $p < 0.001$), and access to information resources ($\rho = 0.763$, $p < 0.001$). Regression analysis revealed that exposure to infectious disease training ($\beta = 0.420$, $p < 0.001$) and access to health information resources ($\beta = 0.416$, $p < 0.001$) were significant predictors of VHF knowledge, while academic level was not ($\beta = 0.105$, $p = 0.137$). The model explained 65.8% of the variance in VHF knowledge.

Conclusion: Although academic progression moderately correlates with VHF knowledge, it does not independently predict preparedness. Instead, structured infectious disease training and strong access to credible health information are the most powerful determinants of students' VHF-related competence. Strengthening simulation-based training, digital health literacy, and access to scientific resources is therefore essential to building an outbreak-ready health workforce in Rwanda.

KEYWORDS: Viral Hemorrhagic Fevers, infectious disease training, academic level, digital health literacy, health information resources, health science students, Rwanda.

INTRODUCTION

Viral Hemorrhagic Fevers (VHFs) such as Ebola, Marburg, Lassa fever, and Crimean-Congo Hemorrhagic Fever represent some of the most devastating infectious diseases affecting global health systems. As outbreaks continue to emerge in different regions of the world, the preparedness of health science students future frontline responders depends significantly on their knowledge and competencies related to detection, prevention,

License: This is an open access article under the CC BY 4.0 license: https://creativecommons.org/licenses/by/4.0/

and control of VHFs. Understanding the determinants that shape their level of knowledge is essential for strengthening public health readiness and improving outbreak response capacity.

Globally, research shows that the knowledge of VHFs among health science students is strongly influenced by academic level, exposure to infectious disease training, and access to health information resources. Students in higher academic levels consistently report stronger knowledge; for example, postgraduate students show significantly better understanding of VHF concepts compared to undergraduates, with some studies reporting over 95% awareness of Ebola symptoms and prevention among advanced students (Kayupova et al., 2024). Structured infectious disease training greatly boosts preparedness, with 87.1% of final-year biomedical students reporting they felt "adequately prepared" after targeted VHF-focused instruction (Goderdzishvili & Nikoleishvili, 2025). Access to online health information also plays a major role: 67.4% of students globally use the internet for health information, yet only 33.1% can differentiate scholarly from non-scholarly sources, reflecting gaps in digital health literacy (Utunen et al., 2024). These findings highlight the crucial interplay between academic progression, training exposure, and digital resource access in shaping VHF-related knowledge.

Across Africa, where VHFs are endemic, similar trends reveal that knowledge increases with academic level, targeted training, and access to accurate health information resources. Studies report significant differences in awareness based on education level, with students in clinical training showing notably higher VHF understanding. Infectious disease workshops and outbreak response activities demonstrate strong effects; for instance, over 90% of trainees in structured VHF programs report improved readiness and confidence (Bonkoungou et al., 2025). However, limited access to health information remains a persistent barrier. Only about 67% of African health students use the internet to retrieve medical information, and many struggle with poor connectivity or low e-health literacy (Chereka et al., 2025). These disparities suggest that despite improvements in training and education, African students still face substantial barriers in accessing updated, credible VHF-related scientific knowledge.

In Rwanda, emerging and re-emerging VHFs such as Ebola, Marburg, and Rift Valley Fever underscore the urgent need for well-prepared health professionals. Evidence indicates that academic progression is a major determinant of knowledge, consistent with global findings. Rwanda's infectious disease training programs demonstrate strong outcomes; notably, graduates of the Field Epidemiology and Laboratory Training Program reported 96.7% preparedness for outbreak response after completing their training (Ruseesa et al., 2025). Rwanda has also shown increasing use of digital health resources, yet similar to other African countries, gaps persist due to limitations in digital health literacy and unequal access to scientific journals. Despite improvements, many health science students still rely on general public health awareness rather than structured, evidence-based training highlighting the need for standardized VHF curriculum integration across institutions.

Although regional and international studies emphasize the importance of academic level, infectious disease training, and access to health information resources in shaping students' knowledge of VHFs, no quantitative study in Rwanda has systematically examined these determinants among health science students across universities. Existing evidence remains fragmented, with limited focus on institutional variations in training quality, digital health literacy, and curriculum exposure. Furthermore, no published study has specifically assessed these determinants among students in Rwandan universities such as University of Gitwe, East African Christian College, and Institut Catholique de Kabgayi (ICK). This gap highlights a critical need for a comprehensive, data-driven assessment to inform academic policy, strengthen outbreak preparedness, and support Rwanda's national public health security agenda.

Research Questions

1. To what extent does academic level influence knowledge regarding Viral Hemorrhagic Fevers among health science students in Rwanda?

2. To what extent does exposure to infectious disease training influence knowledge regarding Viral Hemorrhagic Fevers among health science students in Rwanda, in terms of:

a. Coursework
b. Seminars
c. Workshops
d. Outbreak preparedness drills

3. To what extent does access to health information resources influence knowledge regarding Viral Hemorrhagic Fevers among health science students in Rwanda, in terms of:

a. Internet access
b. Scientific journals
c. Public health guidelines
d. Digital health literacy

4. Is there a significant relationship between the independent variables and knowledge regarding Viral Hemorrhagic Fevers among health science students in Rwanda, in terms of:

a. Academic level
b. Exposure to infectious disease training
c. Access to health information resources

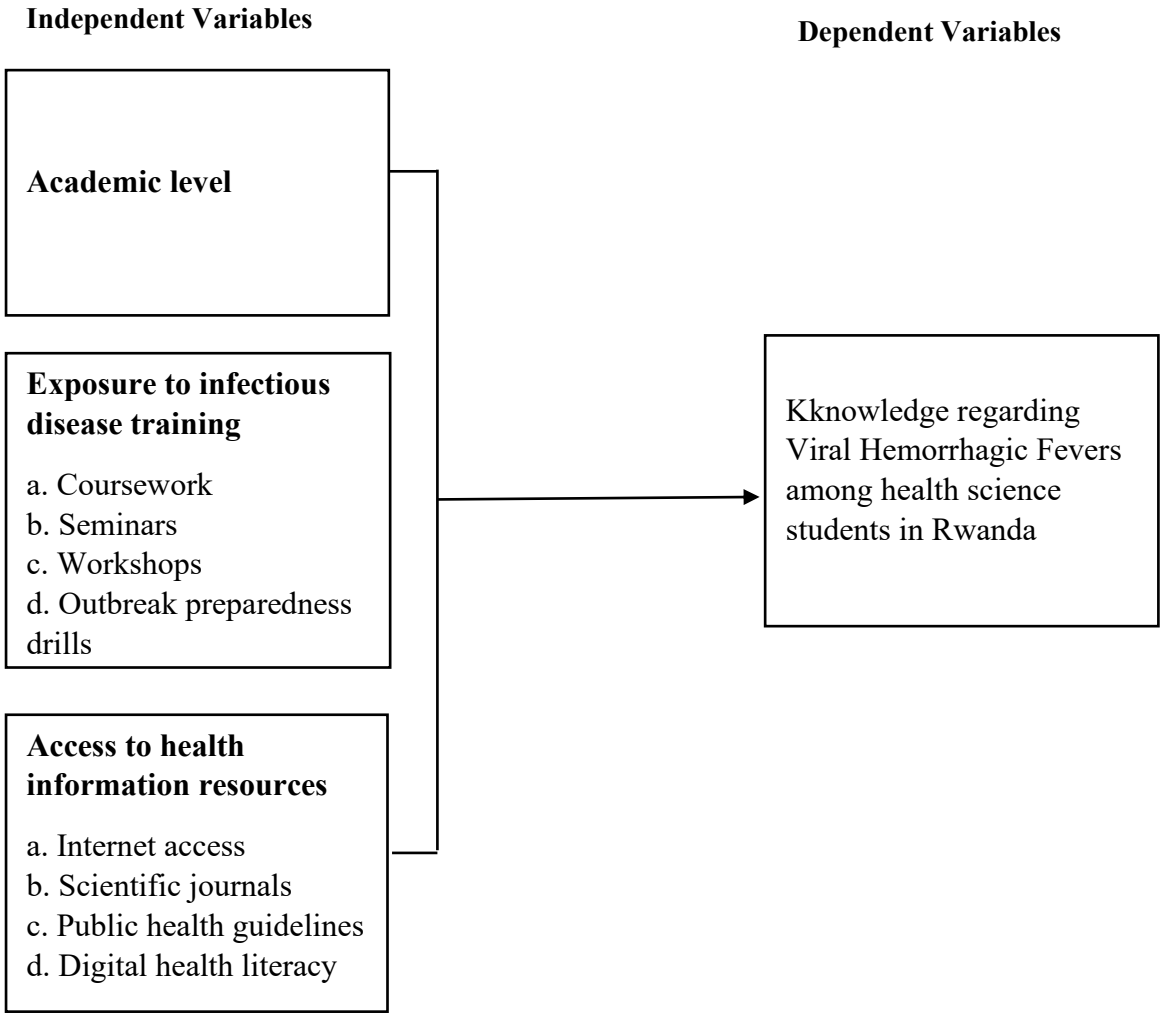
5. Which of the independent variables significantly predict knowledge regarding Viral Hemorrhagic Fevers among health science students in Rwanda, in terms of:

a. Academic level
b. Exposure to infectious disease training
c. Access to health information resources

License: This is an open access article under the CC BY 4.0 license: https://creativecommons.org/licenses/by/4.0/

Conceptual Framework

As Figure 1 shows, this study explored the relationship between academic level, exposure to infectious disease training, and access to health information resources and the level of knowledge regarding Viral Hemorrhagic Fevers among health science students in selected Rwandan universities.



Methodology Sample

This study employed a quantitative, cross-sectional design to assess determinants of knowledge regarding Viral Hemorrhagic Fevers (VHFs) among health science students in three Rwandan universities: University of Gitwe, Institut Catholique de Kabgayi (ICK), and East African Christian College (EACC). A total of 180 students from various health programs and academic levels were selected using stratified random sampling to ensure representative coverage. Data were collected through a structured, self-administered questionnaire covering personal and academic profiles, academic level indicators, exposure to infectious disease training, access to health information resources, and VHF knowledge. The instrument was validated through expert review and a pilot study, demonstrating high reliability (Cronbach's alpha 0.78–0.89). Ethical approval, informed consent, and confidentiality measures were strictly observed. Data were analyzed using SPSS 25, employing descriptive statistics, Pearson correlation, and multiple linear regression, to examine relationships and predictors of VHF knowledge, with significance set at $p < .05$.

RESULT AND DISCUSSION

Respondents' Perceived Influence of Academic Level on Knowledge Regarding VHFs

Table 1 demonstrates that academic level has a strong influence on students' knowledge regarding Viral Hemorrhagic Fevers (VHFs), evidenced by a grand mean of *3.131 (SD = 0.9429)*, which falls within the "Agree/High" category. The highest mean score was recorded for the statement on academic progression improving retention of disease prevention and management information *(Mean = 3.29, SD = 0.910)*, followed closely by enhanced understanding through academic level *(Mean = 3.24, SD = 0.920)* and strengthened comprehension from classroom discussions *(Mean = 3.21, SD = 0.924)*. These consistently high ratings indicate that as students advance academically, they gain deeper knowledge of VHFs and become better equipped to recognize symptoms and preventive measures.

Despite the overall high agreement, some items registered slightly lower assessments, such as the comprehensiveness of curriculum coverage *(Mean = 2.94, SD = 0.938)* and awareness of outbreak management procedures *(Mean = 3.02, SD = 0.967)*. These findings suggest that while

License: This is an open access article under the CC BY 4.0 license: https://creativecommons.org/licenses/by/4.0/

academic progression enhances VHF-related knowledge, gaps remain in curriculum depth and practical preparedness. Strengthening outbreak management training, integrating simulation-based learning, and enriching VHF-focused coursework may address these weaknesses. Overall, the results affirm that academic level significantly shapes students' readiness to manage VHFs, underscoring the need for continuous curricular improvement in Rwanda's health science education system.

Table 1. Respondents' Perceived Influence of Academic Level on Knowledge Regarding VHFs

No.	Perceived Influence of Academic Level on Knowledge Regarding VHFs	Mean	SD	Scale Response	Qualitative descriptor
1.	My academic level has enhanced my understanding of infectious diseases, including VHFs.	3.24	0.920	Agree	**High**
2.	Advanced years of study provide more opportunities to learn about VHFs.	3.18	0.918	Agree	**High**
3.	My department's curriculum covers VHFs comprehensively.	2.94	0.938	Agree	**High**
4.	Postgraduate students possess greater knowledge about VHFs compared to undergraduates	2.96	1.022	Agree	**High**
5.	My academic progression improves my retention of information about disease prevention and management.	3.29	0.910	Agree	**High**
6.	Classroom discussions and lectures have strengthened my understanding of VHFs.	3.21	0.924	Agree	**High**
7.	My academic level affects my awareness of outbreak management procedures.	3.02	0.967	Agree	**High**
8.	I am confident that my year of study influences my readiness to manage VHF cases.	3.18	0.930	Agree	**High**
9.	Students in higher academic levels are generally better prepared for VHF-related emergencies.	3.11	0.970	Agree	**High**
10.	My academic experience equips me to identify symptoms and preventive measures for VHFs.	3.18	0.930	Agree	**High**
Grand Mean		**3.131**	**0.9429**	**Agree**	**High**

Legend: *1.00 -1.49 = Strongly Disagree, 1.50-2.49 = Disagree, 2.50-3.49 =Agree ,3.50-4.00 = Strongly Agree*

Respondents' Perceived Influence of Infectious Disease Training Exposure on Knowledge Regarding VHFs

The findings reveal that exposure to infectious disease training through coursework, seminars, workshops, and outbreak preparedness drills that significantly enhances health science students' knowledge of Viral Hemorrhagic Fevers (VHFs). Overall, the grand mean of 2.999 (SD = 0.912) indicates strong agreement that these training platforms contribute positively to students' understanding of VHF symptoms, transmission, prevention, and outbreak management. Among the four modalities, outbreak preparedness drills received the highest mean scores (3.00–3.07), followed closely by workshops (2.97–3.01), while coursework (2.87–3.09) and seminars (2.94–3.00) also demonstrated high perceived influence. This shows that practical, experience-based learning slightly outperforms theoretical instruction in enhancing readiness and confidence for real outbreak situations.

Despite generally high ratings, some gaps remain. Coursework coverage of emerging infectious diseases received the lowest mean (2.87, SD = 0.934), and seminars showed moderate variability (2.94–3.00), reflecting inconsistencies in curriculum depth and seminar quality. These results highlight the need for standardized and comprehensive VHF training, particularly in practical exercises and structured seminars. Strengthening these areas can improve preparedness among Rwanda's health science students, ensuring they are better equipped for outbreak response and public health management.

License: This is an open access article under the CC BY 4.0 license: https://creativecommons.org/licenses/by/4.0/

Table 2. Respondents' Perceived Influence of Infectious Disease Training Exposure on Knowledge Regarding VHFs

No.	Perceived Influence of Infectious Disease Training Exposure on Knowledge Regarding VHFs.	Mean	SD	Scale Response	Qualitative descriptor
	Course Work				
1.	My coursework has effectively covered emerging infectious diseases such as VHFs.	2.87	0.934	Agree	**High**
2.	Classroom lectures provide sufficient knowledge on VHF symptoms, transmission, and prevention.	3.05	0.843	Agree	**High**
3.	My coursework strengthens my understanding of VHF outbreak management strategies.	3.05	0.894	Agree	**High**
4.	Theoretical lessons in my courses improve my readiness to respond to infectious disease emergencies.	3.09	0.843	Agree	**High**
	Seminars				
5.	Attending seminars has enhanced my understanding of VHFs.	2.94	0.968	Agree	**High**
6.	Seminars provide up-to-date knowledge on emerging infectious diseases.	2.98	0.910	Agree	**High**
7.	Participating in seminars increases my confidence in managing VHF-related cases.	2.96	0.942	Agree	**High**
8.	Seminars encourage me to engage in public health preparedness activities.	3.00	0.895	Agree	**High**
	Workshops				
9.	Workshops provide practical skills to handle VHFs effectively.	2.97	0.930	Agree	**High**
10.	Post-workshop assessments improve my understanding of infectious disease management.	3.00	0.913	Agree	**High**
11.	Workshops bridge the gap between theory and practice in VHF management.	2.97	0.930	Agree	**High**
12.	Practical exercises during workshops enhance my readiness for outbreak situations.	3.01	0.908	Agree	**High**
	Outbreak Preparedness Drills				
13.	Participation in outbreak preparedness drills increases my confidence in managing VHFs.	3.03	0.915	Agreee	**High**
14.	I feel more prepared to respond to real VHF outbreaks after participating in drills.	3.00	0.920	Agree	**High**
15.	Outbreak simulations help me apply infection control measures effectively.	3.07	0.943	Agree	**High**
Grand Mean		**2.999**	**0.912**	**Agree**	**High**

Legend: *1.00 -1.49 = Strongly Disagree, 1.50-2.49 = Disagree, 2.50-3.49 =Agree ,3.50-4.00 = Strongly Agree*

Respondents' Perceived Influence of Access to Health Information Resources on Knowledge Regarding VHFs

The findings indicate that access to health information resources significantly influences health science students' knowledge regarding Viral Hemorrhagic Fevers (VHFs). Overall, the grand mean of *2.947 (SD = 0.956)* shows strong agreement that these resources enhance understanding of VHF symptoms, transmission, prevention, and outbreak management. Among the four domains, internet access received mean scores ranging from *2.89 to 2.97*, highlighting that reliable connectivity and effective use of online platforms strengthen students' preparedness for outbreaks. Scientific journals were similarly influential *(Mean = 2.87–3.02)*, with access to journals and open-access research supporting evidence-based knowledge acquisition.

Public health guidelines also demonstrated high perceived impact, with mean scores between *2.93* and *3.05,* reflecting their role in improving understanding of preventive measures and guiding outbreak response. Digital literacy showed consistent high ratings (*Mean = 2.92–2.97),* emphasizing students' confidence in evaluating online health information and integrating digital resources with theoretical and practical learning.

License: This is an open access article under the CC BY 4.0 license: https://creativecommons.org/licenses/by/4.0/

These findings suggest that while all four resources are valuable, scientific journals and public health guidelines slightly outperform others, and that strengthening internet infrastructure and digital health literacy can further enhance students' preparedness for VHF outbreaks in Rwanda.

Table 3. Respondents' Perceived Influence of Access to Health Information Resources on Knowledge Regarding VHFs

Legend: *1.00 -1.49 = Strongly Disagree, 1.50-2.49 = Disagree, 2.50-3.49 =Agree ,3.50-4.00 = Strongly Agree*

No.	Respondents' Perceived Influence of Access to Health Information Resources on Knowledge Regarding VHFs	Mean	SD	Scale Response	Qualitative descriptor
	Internet Access				
1.	I have reliable internet access to retrieve health-related information.	2.89	0.989	Agree	**High**
2.	My internet access allows me to stay updated on emerging infectious diseases such as VHFs.	2.92	1.018	Agree	**High**
3.	I use online platforms effectively to research information about VHFs.	2.94	0.950	Agree	**High**
4.	Internet connectivity enhances my readiness to manage VHF outbreaks.	2.97	0.933	Agree	**High**
	Scientific Journals				
5.	Access to scientific journals enhances my knowledge about VHFs.	3.02	0.952	Agree	**High**
6.	I regularly consult peer-reviewed articles to improve my understanding of infectious diseases.	2.87	1.003	Agree	**High**
7.	Open access journals are valuable resources for keeping up-to-date with VHF research.	2.94	0.943	Agree	**High**
	Public Health Guidelines				
8.	I can access public health guidelines related to VHFs through my university or online.	2.93	0.948	Agree	**High**
9.	Public health guidelines improve my understanding of preventive measures for VHFs.	3.05	0.929	Agree	**High**
10.	I refer to public health guidelines when learning about outbreak response and management.	2.98	0.902	Agree	**High**
11.	I can critically evaluate online health information related to VHFs.	2.94	0.931	Agree	**High**
	Digital Literacy				
12.	I am confident in using digital tools to access accurate health information.	2.93	0.964	Agree	**High**
13.	My digital health literacy helps me distinguish credible from non-credible online sources.	2.92	0.959	Agreee	**High**
14.	I use digital resources to complement my theoretical and practical knowledge on VHFs.	2.97	0.969	Agree	**High**
Grand Mean		**2.947**	**0.956**	**Agree**	**High**

License: This is an open access article under the CC BY 4.0 license: https://creativecommons.org/licenses/by/4.0/

The relationship between academic level, exposure to infectious disease training, access to health information resources, and knowledge regarding Viral Hemorrhagic Fevers (VHFs) among health science students in Rwanda.

Table 4 presents the Spearman correlation analysis assessing the relationship between academic level, exposure to infectious disease training, access to health information resources, and knowledge regarding Viral Hemorrhagic Fevers (VHFs) among health science students in Rwanda. The analysis shows a moderate positive correlation between academic level and VHF knowledge ($\rho = 0.661$, $p < 0.001$), indicating that as students progress academically, their understanding of VHF symptoms, transmission, prevention, and outbreak management improves significantly. This finding aligns with global and regional evidence that higher academic levels enhance students' ability to integrate theoretical and practical knowledge on emerging infectious diseases.

Furthermore, both exposure to infectious disease training and access to health information resources demonstrated strong positive correlations with VHF knowledge, with *$\rho = 0.766$ ($p < 0.001$)* and *$\rho = 0.763$ ($p < 0.001$)*, respectively. These results suggest that targeted training programs, workshops, seminars, and reliable access to digital health resources, scientific journals, and public health guidelines substantially improve students' readiness and competence in managing VHFs. The findings highlight the critical importance of integrating structured infectious disease training and promoting access to credible health information within health science curricula to strengthen Rwanda's public health preparedness and outbreak response capacity.

Table 4. Relationship Between Determinants and Knowledge Regarding VHFs

Variable	Spearman's ρ	P-value	Decision	Interpretation
Academic level	0.661***	p < 0.001	Reject Ho	Moderate Positive Correlation
Exposure to infectious disease training	0.766***	p < 0.001	Reject Ho	Strong Positive Correlation
Access to Health information resources	0.763***	p < 0.001	Reject Ho	Strong Positive Correlation

Legend: *0.00–0.10 = Negligible; 0.10–0.39 = Weak Correlation; 0.40–0.69 = Moderate Correlation; 0.70–0.89 = Strong Correlation; 0.90–1.00 = Very Strong Correlation*

Predictors of Knowledge Regarding Viral Hemorrhagic Fevers Among Health Science Students in Rwanda

Table 5 presents the multiple regression analysis examining the predictive effect of academic level, exposure to infectious disease training, and access to health information resources on students' knowledge regarding Viral Hemorrhagic Fevers (VHFs). Among the three independent variables, exposure to infectious disease training *($\beta = 0.420$, $p < 0.001$)* and access to health information resources *($\beta = 0.416$, $p < 0.001$)* emerged as significant predictors of VHF knowledge, indicating strong positive contributions. Academic level *($\beta = 0.105$, $p = 0.137$)* did not significantly predict knowledge, suggesting that progression through academic years alone is not sufficient to enhance students' preparedness for managing VHFs. The R^2 value of *0.658* demonstrates that these three variables collectively explain *65.8%* of the variance in students' VHF knowledge, highlighting the substantial impact of training and resource access on learning outcomes.

Relative contributions of the predictors, calculated from R^2 change values, reveal that exposure to infectious disease training accounted for *36.5%,* access to health information resources contributed *36.3%*, and academic level contributed *27.2%* to the explained variance. This distribution underscores that while formal coursework progression plays a role, structured training and reliable access to digital and scholarly resources are the primary drivers of knowledge acquisition. These findings support the integration of practical infectious disease training and digital health literacy enhancement in curricula to strengthen the preparedness of future frontline health professionals in Rwanda.

Table 5. Multiple Regression Analysis Predicting Knowledge of VHFs

Predictor	Estimate (β)	SE	t	p	R^2 Change	Percentage
Intercept	0.213	0.15000	1.42	0.156	0.813	
Academic Level	0.105	0.0706	1.49	0.137	0.437	27.2%
Exposure to infectious disease training	0.420	0.0804	5.23	<0.001	0.586	36.5%
Access to health information resources	0.416	0.0675	6.16	<0.001	0.582	36.3%

CONCLUSION

The findings of this study reveal that health science students in Rwanda possess a generally high level of knowledge regarding Viral Hemorrhagic Fevers (VHFs), shaped primarily by their exposure to infectious disease training and access to health information resources. While academic level demonstrated a moderate positive correlation with VHF knowledge, it did not significantly predict students' competence in the regression model, suggesting that academic progression alone is insufficient for optimal preparedness. Instead, targeted training programs including coursework, seminars, workshops, and outbreak preparedness drills has emerged as strong determinants of VHF-related knowledge. Similarly, access to digital platforms, scientific journals, public health guidelines, and high digital health literacy significantly enhanced students' capacity to understand symptoms, transmission pathways, prevention measures, and outbreak management strategies.

The analysis confirms that structured infectious disease training *(36.5%)* and access to health information resources *(36.3%)* are the most influential predictors of VHF knowledge, followed by academic level *(27.2%).* These findings underscore that students' preparedness to respond to VHF outbreaks is primarily driven by practical exposure and resource availability rather than academic standing alone. In essence, strengthening knowledge and readiness requires more than curricular progression, and it necessitates intentional investments in high-quality training, practical simulations, and improved access to accurate, credible health information. Therefore, to build a resilient and outbreak-ready health workforce,

License: This is an open access article under the CC BY 4.0 license: https://creativecommons.org/licenses/by/4.0/

Rwanda must continue advancing competency-based educational approaches, digital health literacy, and evidence-based infectious disease training across its health science programs.

RECOMMENDATIONS

For Educational Institutions and Health Training Schools: Universities and health training institutions should enhance the integration of structured infectious disease training into their curricula. This includes expanding practical components such as outbreak simulations, skills-based workshops, and laboratory demonstrations. Schools should also strengthen digital literacy programs to equip students with the ability to critically evaluate online health information and responsibly use digital platforms for evidence-based learning. Additionally, institutions should review and enrich the coverage of VHF-related content within core courses to address gaps in curriculum comprehensiveness identified in the study.

For the Ministry of Health (MoH) and Rwanda Biomedical Centre (RBC): The Ministry of Health and RBC should collaborate with training institutions to standardize and accredit infectious disease training modules across universities. Strengthening partnerships between academia and public health agencies can ensure consistent delivery of up-to-date guidelines, outbreak management protocols, and hands-on preparedness drills. The MoH should also support the development of national repositories of open-access scientific materials and public health guidelines to enhance equitable access to credible health information among students.

For the Ministry of Education and Higher Education Council (HEC): The Ministry of Education and HEC should advance policies that promote investment in digital infrastructure, including reliable internet connectivity and access to scientific databases across all health science institutions. Given the strong impact of health information access on VHF knowledge, institutions with limited digital resources should be prioritized. Policymakers are encouraged to support the development of unified digital learning platforms to ensure that all students regardless of institutional location that benefit from high-quality digital health resources essential for infectious disease preparedness.

For Public Health Stakeholders and Community Health Programs: Community health partners and NGOs should work with universities to offer supplementary training opportunities such as seminars, workshops, and community-based outbreak preparedness activities. These collaborations can extend practical exposure beyond the classroom and foster a stronger culture of public health readiness among students. Encouraging participation in community health outreach activities can also enhance students' applied understanding of infectious disease prevention and control.

For Families and Communities: Families and community leaders should continue encouraging health science students to actively engage in training opportunities, access credible health information, and participate in outbreak preparedness activities. Supportive environments contribute to confidence-building and reinforce learning, ensuring that students remain motivated to strengthen their infectious disease competencies. Community awareness efforts about VHFs can also complement formal education by promoting public health consciousness.

For Future Researchers: Future research should consider longitudinal or experimental designs to evaluate how sustained exposure to training and digital health resources influences long-term knowledge retention and outbreak response competence. Studies comparing multiple universities or regions would also help identify disparities in training opportunities, digital resource access, and curriculum implementation. Additionally, qualitative research exploring students' lived experiences, learning challenges, and training needs would provide deeper insights to guide curriculum policy and infectious disease preparedness strategies in Rwanda.

REFERENCES

1) Bonkoungou, B., Mosha, F., Abianuru, A., Okeibunor, J., Utunen, H., Balaciano, G., De Lima, A. C. B., Burke, L., McKenna, S., Nag, S., Gueye, A. S., & Struminger, B. (2025). The evolutionary journey to a new normal for learning and capacity building of healthcare workers to prepare and respond to health emergencies across Africa. *Frontiers in Public Health*, *12*, 1455444. https://doi.org/10.3389/fpubh.2024.1455444
2) Chereka, A. A., Shibabaw, A. A., Butta, F. W., Tadesse, M. N., Abebe, M. T., Atanie, F. A., & Kitil, G. W. (2025). Explore barriers to using the internet for health information access in African countries: A systematic review. *PLOS Digital Health*, *4*(1), e0000719. https://doi.org/10.1371/journal.pdig.0000719
3) Da Silva Paixão, M. É., Silva, M. E. F., Nunes, E. M., Nogueira, M. F., & Ribeiro, L. C. S. (2023). Conhecimento de estudantes e servidores universitários sobre a Covid-19. *Revista Eletrônica Acervo Saúde*, *23*(8), e13072. https://doi.org/10.25248/reas.e13072.2023
4) Goderdzishvili, D., & Nikoleishvili, E. (2025). Strengthening Pandemic Preparedness in Undergraduate Education through Curricular Reform: Post-COVID-19 Insights. *European Scientific Journal ESJ*, *21*(24), 1. https://doi.org/10.19044/esj.2025.v21n24p1
5) Karuhije, J., Nkeshimana, M., Zakham, F., Hewins, B., Rutayisire, J., Martinez, G. S., Kelvin, D. J., & Ndishimye, P. (2023). Understanding Knowledge, Attitudes and Practices on Ebola Virus Disease: A Multi-Site Mixed Methods Survey on Preparedness in Rwanda. *Research Square*. https://doi.org/10.21203/rs.3.rs-2331005/v1
6) Karuhije, J., Nkeshimana, M., Zakham, F., Hewins, B., Rutayisire, J., Martinez, G. S., Kelvin, D., & Ndishimye, P. (2022). Understanding Knowledge, Attitudes and Practices on Ebola virus disease: A Multi-Site Mixed Methods Survey on Preparedness in Rwanda. *bioRxiv (Cold Spring Harbor Laboratory)*. https://doi.org/10.1101/2022.11.03.22281885
7) Kayupova, G., Takuadina, A., Bolatova, Z., Dauletkaliyeva, Z., Yerdessov, N., Nukeshtayeva, K., & Zhamantayev, O. (2024). General, vaccination, navigational and digital health literacy of students enrolled in different medical and health educational programs. *Healthcare*, *12*(9), 907. https://doi.org/10.3390/healthcare12090907
8) Mukona, D. M., George, R., James, J., Joseph, S., Mukasa, J., Timberlake, C., Monaco, B., Abdulla, S., Khalaf, A., & Burnett, E. (2024). Preparedness for infection prevention and control practice among undergraduate health sciences students: A systematic review protocol. *Journal of Infection Prevention*, *25*(6), 236–241. https://doi.org/10.1177/17571774241236247

License: This is an open access article under the CC BY 4.0 license: https://creativecommons.org/licenses/by/4.0/

Corresponding Author: *Simon Pierre Ndayishimye Mvuyekure

9) Ruseesa, E., Hagabimana, A., Ntirenganya, F., Kinani, P., Hinda, R., Nshimiyimana, E., Niyoyita, C., Umutoni, A., Stamatakis, C., Mucunguzi, H. V., & Rwagasore, E. (2025). The role of Rwanda Field Epidemiology and Laboratory Training Program graduates and residents in response to the first Marburg Virus Disease outbreak in Rwanda. *PLOS Global Public Health*, *5*(9), e0004452. https://doi.org/10.1371/journal.pgph.0004452
10) Utunen, H., Balaciano, G., Arabi, E., Tokar, A., Bhatiasevi, A., & Noyes, J. (2024). Learning interventions and training methods in health emergencies: A scoping review. *PLoS ONE*, *19*(7), e0290208. https://doi.org/10.1371/journal.pone.0290208

License: This is an open access article under the CC BY 4.0 license: https://creativecommons.org/licenses/by/4.0/

Corresponding Author: *Simon Pierre Ndayishimye Mvuyekure