

1 **Initiatives and strategies to strengthen the national, regional, and international Global**
2 **Health Security: A case study of Rwanda Biomedical Centre**

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22 **Summary:**

23 **Background**

24 Global Health Security (GHS) is an emerging significant concern for the security, health, social,
25 economic, political, and ecological structure and stability worldwide. GHS is a multifaceted
26 issue involving several risk factors and manifestations, and it presents a serious challenge for
27 health systems, governments, and other stakeholders universally. Therefore, strengthening
28 the GHS requires long-term commitment and investment in establishing infrastructures,
29 upgrading health systems, and integrating multisectoral and transdisciplinary One Health
30 strategy. Furthermore, considering that GHS issues have no borders and commonly grow into
31 cross-countries threat, a successful improvement of the GHS requires extensive national,
32 regional, and global collaboration, cooperation, and coordination.

33 **Methods**

34 Here we deployed mixed tools and methods including participatory methods through technical
35 consultations, surveys, and assessment exercises to implement an institutional assessment,
36 situational and risk analysis to identify and document institutional capacity, practices, and
37 initiatives that were implemented to strengthen GHS at the national, regional, and global levels.

38 **Findings**

39 We have identified several initiatives and practices that were pioneered and led from Rwanda
40 with focus on leveraging cost-effective strategic planning, implementation of activities and
41 evidence-based interventions to continuously improve the GHS in the country, the region, and
42 globally. These initiatives including building the institutional capacity by merging fourteen
43 national health related institutions into a single institute, resulting in the establishment of
44 Rwanda Biomedical Centre (RBC) in 2011, which is currently the leading agency for
45 implementing the health system including healthcare and public health services in the country.
46 This was immediately followed by developing the health system workforce to accelerate

47 achieving Universal Healthcare Coverage by training about 60,000 community health workers
48 to deliver high quality care at home, which was proven crucial during the response to COVID-
49 19 in Rwanda. In overall, we identified four, ten, twelve, and seven main initiatives led by RBC
50 in collaboration with several stakeholders to strengthen the institutional, national, regional, and
51 global capacity to improve GHS, respectively.

52 **Interpretation**

53 Improving GHS requires multisectoral collaboration, cross-countries cooperation, and the
54 implementation of transdisciplinary One Health strategy. Considering that several risk factors
55 for GHS are prevalent in Africa and the region vulnerability to climate change, more investment
56 is needed to strengthen GHS and pandemic preparedness and response in the region.

57 **Funding**

58 This study has received no funding.

59

60 **Keywords:** Pandemic Preparedness Framework; Transdisciplinary One Health Strategy;
61 Multisectoral collaboration; Cross-countries coordination; International Health Regulations;
62 Universal Healthcare Coverage; Equity in healthcare.

63 **Research in context:**

64 **Evidence before this study**

65 Despite the growing threat to the GHS throughout the world including Africa, yet little is
66 known about the current situation of GHS there, existed practices, Africa-originated
67 initiatives, and currently implemented strategies to improve the GHS and pandemic
68 preparedness and response. Nevertheless, Africa is endemic with most of the pathogens that
69 are very likely to be involved in the development of the next pandemic such as Rift Valley
70 fever. Furthermore, the region is highly vulnerable to climate change, humanitarian crisis,
71 population explosion, and unplanned urbanization. These factors increase the risk of GHS
72 challenges.

73 **Added value of this study**

74 This study provide an evidence of initiatives and strategies that are led from Rwanda to
75 strengthen the Global Health Security. It highlights current situation, risk, gaps, and needs to
76 improve the GHS in the country, region, and globally. More importantly, this synthesized
77 evidence will foster cross-countries cooperation and multisectoral collaboration to secure and
78 safeguard humans, animal, and environmental health globally.

79 **Implications of all the available evidence**

80 Despite the wide range of currently implemented initiatives, still there is urgent need for
81 strategic investments from all stakeholders of health and development to improve the design,
82 planning, and implementation of innovative cost-effective approaches that will collectively
83 improve the Global Health Security. Particularly that, existed evidence shows that
84 Sustainable Developmental Goals will not be achieved without strong GHS.

85 **Introduction:**

86 Global Health Security (GHS) is defined by the World Health Organization (WHO) as “the
87 activities required, both proactive and reactive, to minimize the danger and impact of acute
88 public health events that endanger people's health across geographical regions and
89 international boundaries.”¹ The scope of GHS includes concerns extending to socioeconomic
90 factors, food insecurity, and the safety of humans, animals, and the environment.

91 Several risk factors challenge the current capacity of GHS worldwide, highlighting the urgent
92 need to strengthen national, regional, and international capacities to safeguard health security
93 globally.² The main risk factors for GHS include rapid population growth, globalization, and
94 urbanization, which increase demands for limited resources.³ Additionally, climate change
95 exacerbates issues of resources' availability, affordability, and accessibility.⁴⁻⁶ The impact of
96 these risk factors is evident the increasingly growing frequency and magnitude of global health
97 emergencies and pandemics. Unfortunately, underdeveloped countries with limited resources
98 and vulnerable communities are the most affected by these severe events.⁷⁻⁹

99 Therefore, there is a crucial need enhance partnership and engagement to improve GHS
100 capacity and practices worldwide, particularly in areas with fragile health systems and limited
101 resources, such as Africa.^{1,10,11} In Rwanda, the Rwanda Biomedical Centre (RBC) has
102 engaged and coordinated health stakeholders at the national, regional, and international levels
103 to improve GHS.

104 **Methods:**

105 Participatory methods mainly community-engagement with stakeholders of GHS, health
106 system strengthening, and One Health were implemented through a series of consultative
107 meetings, surveys, and email correspondences. This was supported by systematic institutional
108 assessment, situation and risk analysis that were implemented through multiple exercises of
109 technical experts' consultations and complement on highlighting gaps, needs, and
110 opportunities to be considered in future investments and practices to improve the GHS at

111 different levels of concerns including institutional, national, regional, and globally. We followed
112 the guidelines for participatory methods in research and reporting population health and policy
113 interventions.^{12,13}

114 **Results:**

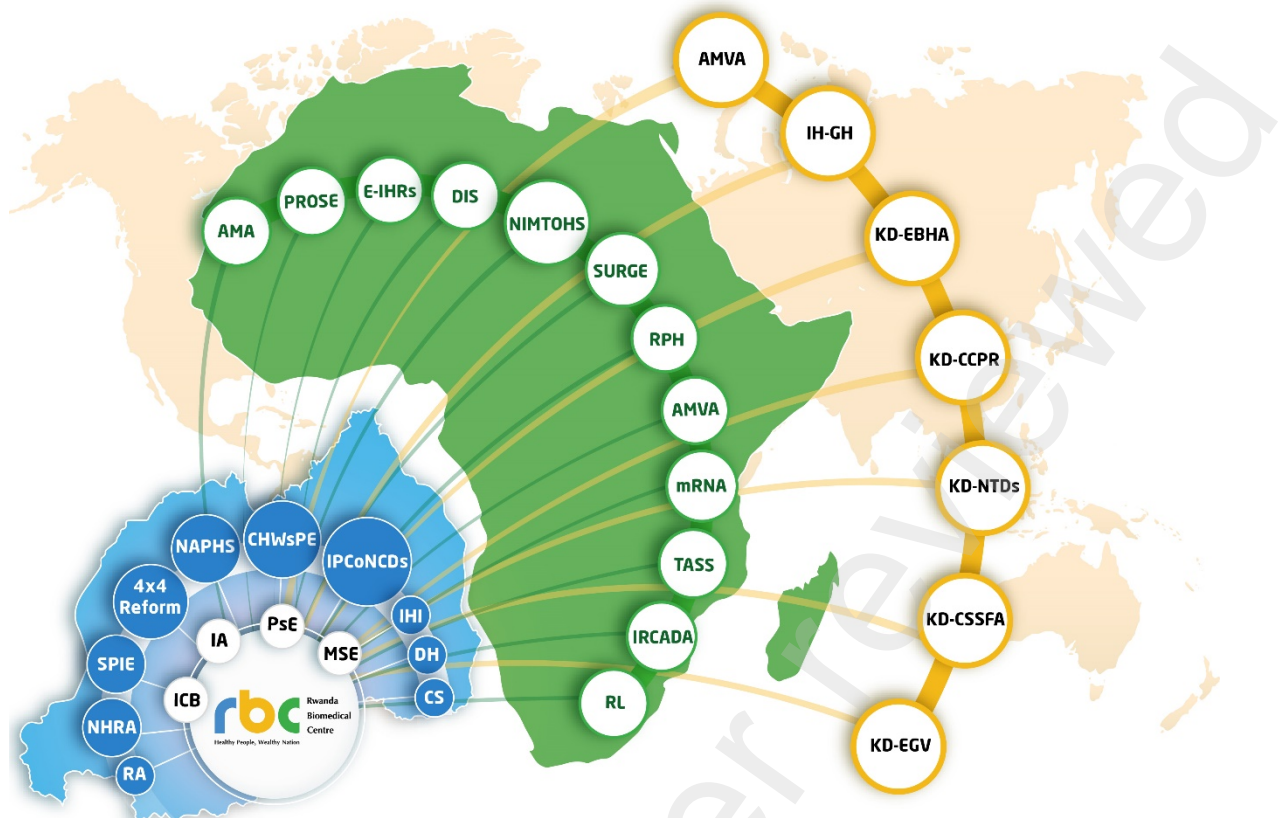
115 In collaboration with various stakeholders, RBC has led several initiatives to strengthen GHS
116 in the country, throughout the African region, and globally. To contribute effectively at these
117 different levels, some initiatives focus on building the institutional capacity, while others aim at
118 reinforcing the health system within the country, enhancing regional collaboration, and
119 fostering global cooperation (Fig. 1). This piece of work highlights practices and initiatives led
120 and coordinated by RBC to support strengthening the national, regional, and global GHS
121 through capacity building, collaboration, cooperation, and coordination.

122 **Strengthening the National Institution:**

123 RBC was established in 2011 through merger of fourteen health-related agencies to enhance
124 efficiency, transparency, and cost-effectiveness, and to eliminate redundancy. This merger
125 brought together national programs for improving healthcare services, and public health
126 practices, and diseases control under a unified leadership.¹⁴ This was enacted by a presidential
127 order; enabling Rwanda to pioneer the initiative that would later be declared in 2012 “Kigali
128 Declaration on Evidence Based Healthcare in Africa (KD-EBHA)”.^{15,16} Consequently, Rwanda
129 adopted evidence-based strategic planning and interventions to improve healthcare and public
130 health services.¹⁶ Accordingly, over the last decade, RBC has achieved substantial progress
131 in the early detection and cost-effective control of endemic diseases such as HIV, malaria, TB,
132 and other neglected tropical diseases (NTDs), resulting in some of the lowest cases and deaths
133 related to HIV, malaria, and TB in Africa.^{17–19}

134 RBC accomplished these improvements through several complementary strategies and
135 approaches, including institutional assessment (IA) to identify gaps, needs, challenges, and
136 opportunities. This was followed by mapping and engaging a wide range of stakeholders (MES)

137 to build strategic partnerships that support building the institute's capacity through technical
138 and financial support.²⁰ RBC, with the support of health stakeholders, invested in institutional
139 capacity building (ICB) through training and strategic recruitment, expanding the outreach of
140 the national programs for diseases control (PsE) (Fig. 1).



141
 142 **Figure 1.** Summarizes initiatives led by RBC to build the institutional capacity and strengthening the Global Health
 143 Security at the national, regional, and global levels. These initiative include **ICB**= Institutional capacity building,
 144 **PsE**= Programs expansion, **MES**: Mapping & engaging Stakeholders, and **IA**= Institutional assessment at the
 145 institutional level. **RA**= Risk Assessment, **4x4 Reform**= Increasing the number of healthcare workers in Rwanda
 146 four-times, **IHI**= Inclusive Health Insurance, **CHWsPE**= Community Health Workers Program's Expansion, and
 147 **NAPs**= National Action Plans for Health Security, Climate Change, & AMR, as well as **NHRA**= National Health
 148 Research Agenda, **DH**= Digitalizing the Health System, **CS**= Collaborative surveillance, **IPCoNCDs**= Initiatives for
 149 the prevention and control of Non-communicable diseases, and **SPIE**= Social protection, inclusiveness, and equity
 150 at the national level. Regional initiatives that aim to enhance the GHS in Africa include the establishment of **RPH**=
 151 Regional Pandemic Hub, **mRNA**= First mRNA Vaccines Plant in Africa, **TASS**= Transforming African Surveillance
 152 System, **PROSE**= Promoting Resilience of System for Emergencies, **SURGE**= Strengthening and Utilizing
 153 Response Groups for Emergencies, **DIS**= Disease Intelligence System, and **E-IHRs**= Enhanced the implementation
 154 of International Health Regulations, **RL**= Reference Laboratory for the diagnosis of TB and monitoring MDR, **AMA**=
 155 African Medicines Agency, as well as **IRCADA**= IRCAD Africa, **IVI**= International Vaccine Institute open Africa
 156 Regional Office in Rwanda, and **NIMTOHS**= Nationally institutionalized multisectoral transdisciplinary One Health
 157 strategy. While global initiatives include **AVMA**= African Vaccines Manufacturing Accelerator, **KD-NTDs**= Kigali
 158 Declaration for the elimination of Neglected Tropical Diseases, **KD-CSSFA**= Kigali Declaration on Climate Science
 159 for a Sustainable Future for All, **KD-EGV**= Kigali Declaration on the Elimination of Gender Violence, **KD-CCPR**=
 160 Kigali Declaration on Child Care and Protection Reform, **KD-EBHA**= Kigali Declaration on Evidence Based
 161 Healthcare in Africa, **GEWE**= Genomic-enhanced Wastewater Epidemiology, Membership of RBC in the leadership
 162 of globally leading initiatives and institutes, and **IH-GH**= International Hub for Global Health.

163 **Initiatives to Strengthen the National Global Health Security (GHS):**

164 RBC has spearheaded efforts to strengthen the health system and national capacity in
165 Rwanda, thereby bolstering GHS at the country level. As part of the policy to lead evidence-
166 based strategic planning and implementation, RBC prioritizes risk and situational analysis as
167 well as operation research to generate high quality data that can be synthesized into evidence
168 to inform decision-making, and guide strategic planning and implementation. This is evident in
169 RBC's leadership in updating the National Health Research Agenda (NHRA) for 2024-2029
170 and several National Action Plans (NAPs), including those for Health Security, Climate
171 Change, and Antimicrobial Resistance (AMR).²¹⁻²⁴

172 Based on the generated evidence, Rwanda, with technical leadership from RBC and guidance
173 from the national Government, has invested in developing an extensive network of Community
174 Health Workers (CHWs), increasing the number of healthcare workers four-times (4x4
175 Reform), and expanded the coverage of the national Inclusive Health Insurance (IHI).²⁵⁻²⁸
176 Furthermore, RBC is progressively investing in the digitalization of the health system including
177 healthcare and public health services to improve services' quality and coverage, facilitate
178 decision-making, monitor and evaluate implementation.²⁸ This includes the digitalization of
179 healthcare provision at healthcare facilities as well as CHWs.

180 The CHWs program in Rwanda has been expanded through multiple phases to grow its
181 capacity to approximately 60,000 trained CHWs who currently deliver about 15 different
182 healthcare and public health services at home and the community level (Table 1). This initiative
183 has improved health equity by bringing services directly to people in need, without any
184 demographic, socioeconomic, or systemic barriers. The ongoing digitalization initiative aims to
185 provide continuous online training, support, mentorship, and supervision, and to enhance the
186 connections between the CHWs and the communities they serve.^{27,29} This is expected to
187 improve early detection, case management, and outcome, as well as reduce reporting time
188 and improve data quality. Ultimately, this program will enable Rwanda to lead the way in
189 achieving high-quality Universal Healthcare Coverage (UHC).

190 **Table 1.** Summarizes the healthcare and public health services that are currently provided by
 191 CHWs.

s/n	Healthcare service by CHWs	Year of initiation	Coverage
1	Nutrition	1995	Nationwide
2	Integrated Community Case management (ICCM)	2004	Nationwide
3	Malaria	2004	Nationwide
4	Tuberculosis (TB)	2005	Nationwide
5	Community Based Maternal New-born Health	2010	Nationwide
6	Community Based Provision Family Planning	2010	Nationwide
7	Report Community health activities	2011	Nationwide
8	Drug management and Supply	2012	Nationwide
9	Non-communicable diseases (NCDs)	2013	Nationwide
10	Mental Health (MH)	2018	In 18 districts*
11	First Aid (FA)	2018	In 18 districts*
12	HIV	2018	In 18 districts*
13	Behaviour Change Communication (BCC)	2018	In 18 districts*
14	Emergency response to epidemics	2018	In 18 districts*
15	Crosscutting services: ECD, ASRH, WASH and	2018	In 18 districts*

192 * Implemented in 18 out of 30 districts trained on polyvalent model, nationwide scale-up
 193 anticipated by 2024.

194 To further enhance early detection and response, RBC is piloting the implementation of
 195 collaborative surveillance (CS) that integrates multiple surveillance and response systems to
 196 improve the efficiency and cost-effectiveness.

197 Additional initiatives for the prevention and control of Non-communicable diseases
 198 (IPCoNCDs) are being implemented to address the growing burden and risk of NCDs. These
 199 initiatives include Car-free Days, the establishment of Car-free zones and ecological parks
 200 throughout the country. Furthermore, the Government prompts the use of environment-friendly
 201 (electric) vehicles through tax exemption policy. Moreover, high-taxation and regulations on
 202 alcohol and smoking have proven cost-effective in reducing consumption and related health
 203 risk, including NCDs and road injuries and deaths. These measures have contributed to
 204 improving the health and socioeconomic status of the community.

205 Appreciating that to effectively strengthening the GHS in the country, this requires fostering
 206 inclusive environment that brings everyone on board and allows them to actively contribute

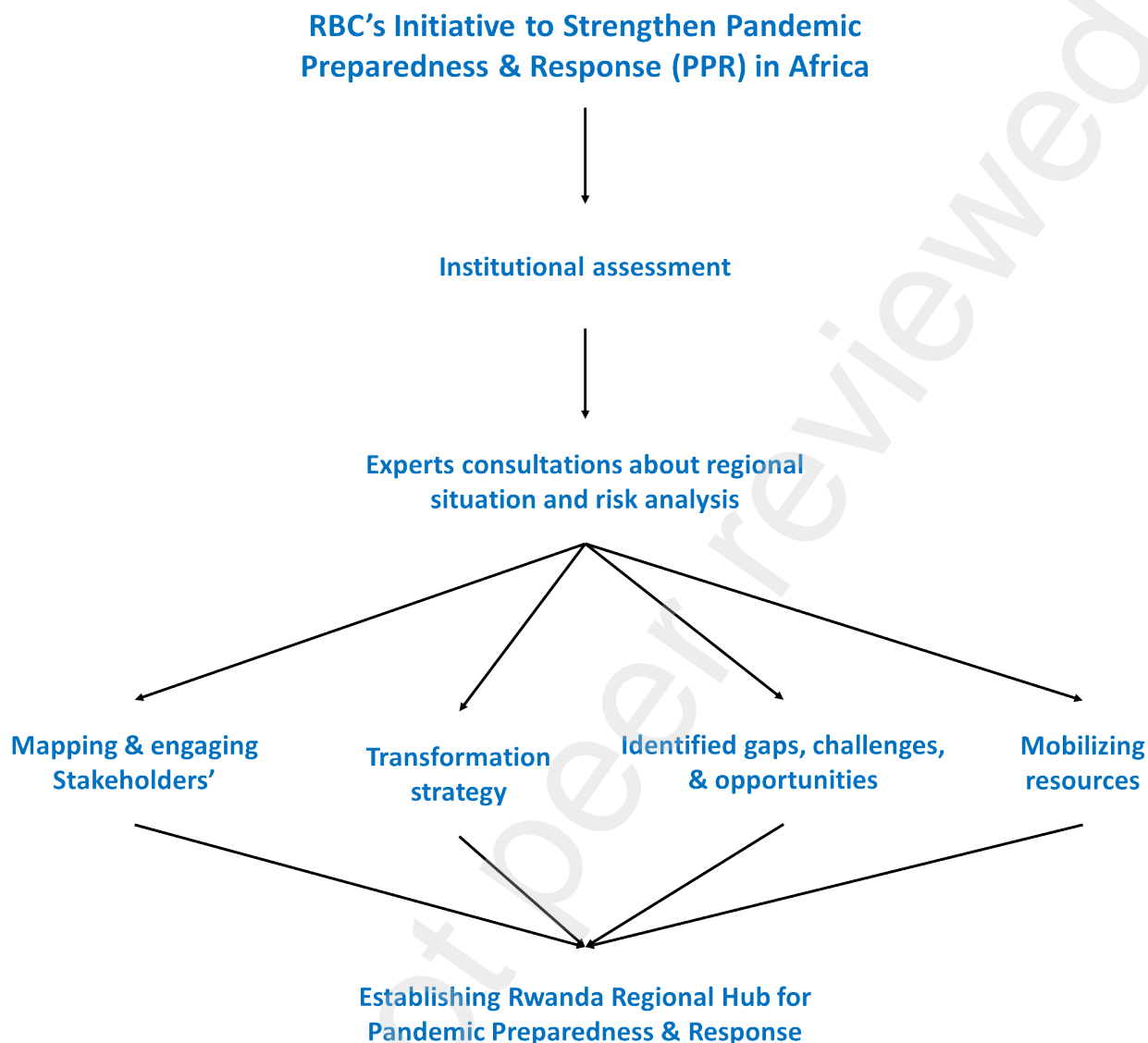
207 and claim their rights regardless of the gender identity, socioeconomic status, and age. The
208 only exception to this diverse, equity, and inclusivity strategy is that the weak, vulnerable,
209 disadvantage, and poor communities as well as individuals with disabilities and specific needs
210 are prioritized in healthcare service delivery, accessibility, and additional support per need.
211 Therefore, in addition to the national policy for gender equity and women empowerment, RBC
212 taking pride in leading the implementation of Social protection, inclusiveness, and equity
213 (SPIE) in the health sector. It implements this in collaboration with the Gender Monitoring Office
214 (GMO) to enforce gender equity, inclusivity, and accountability and empower people of all
215 gender diversity to sustainably grow and actively contribute in the country development. This
216 is ensuring that the rights and equal access to opportunities and services are legally
217 guaranteed and protected by the government to all individuals regardless of their gender
218 identity, sexual orientation, age, socioeconomic status, or any other differential features.

219 **Initiatives to strengthening the regional Global Health Security (GHS) in Africa:**

220 Through the strongly rooted engagement of Rwanda with health issues and associated
221 challenges in Africa, RBC is progressively leading the implementation of several initiatives
222 aimed at improving GHS across the continent.³⁰ One of the foremost investments by RBC is
223 the ongoing establishment of the first state-of-the-art Hub in Africa; the Regional Pandemic
224 Hub (RPH) in Rwanda, which incorporates comprehensive facilities and systems designed to
225 strengthen scientific and technical leadership, strategic planning, and the implementation of a
226 multisectoral pandemic preparedness framework in Africa (Fig. 2). This regional Hub will
227 provide capacity building in both, technical and leadership aspects of pandemic preparedness,
228 following the Transdisciplinary One Health strategy.^{31,32} Additionally, it is structured to provide
229 technical and logistical support to the region to enhance early warning, detection, and response
230 to emerging health, climate, and security related challenges throughout Africa (Fig. 2).

231

232



233
234 **Figure 2.** Shows the process of establishing Regional Pandemic Hub (RPH) in Rwanda.

235 Additional continental initiatives hosted by Rwanda include the African Medicines Agency
 236 (AMA), African Pharmaceutical Technology Foundation (APTF), and establishing the first
 237 mRNA Vaccines Plant in Africa (mRNA).³³ These initiatives aim to improve health equity by
 238 ensuring access to medications and vaccines, an essential component of GHS in the region,
 239 through local production and distribution. This effort is complemented by an initiative to develop
 240 local expertise in Vaccinology in Africa, including vaccine development, production, promotion,
 241 and delivery, through the establishment of regional office of the International Vaccine Institute
 242 (IVI) in Rwanda to serve Africa. Furthermore, IRCAD Africa (IRCADA) initiative prioritises

243 building the capacity of African countries in minimally invasive surgery by increasing the
244 number of highly trained healthcare providers across the region (Fig. 1).^{34,35}

245 In partnership with the World Health Organization (WHO), Rwanda is enhancing health
246 emergency preparedness and readiness through initiatives launched by WHO Regional Office
247 for Africa. These joint initiatives include Transforming African Surveillance Systems (TASS),
248 Promoting Resilience of Systems for Emergencies (PROSE), and Strengthening and Utilizing
249 Response Groups for Emergencies (SURGE).³⁶ Rwanda is also leading the way in the
250 implementation of Disease Intelligence System (DIS), leveraging public-private-partnership
251 (PPP) to provide a proactive universal coverage with effective activities to maintain GHS in the
252 region.³⁰ This is supported by enforcing the implementation of International Health Regulations
253 (IHRs) to improve the cross-country collaboration and coordination in the surveillance and
254 response to emerging health issues.

255 Furthermore, RBC is supporting developing diagnostic capacities across Africa, with a focus
256 on improving the diagnosis, surveillance, monitoring drug resistance, and control of TB through
257 the upcoming Supranational Reference Laboratory (SRL) for TB diagnosis and monitoring
258 multi-drug resistance (MDR).³⁷ RBC's national reference laboratory provides technical and
259 capacity-building support to African countries in the prevention, surveillance, and control of TB
260 and AMR (Fig. 1).

261 Most of these regional initiatives operate through a nationally institutionalized multisectoral
262 transdisciplinary One Health strategy (IMTOHS) that has been well-structured and
263 implemented in Rwanda through RBC since 2011.³¹ This approach has empowered Rwanda
264 to pioneers the practical implementation of cross-countries One Health strategies to improve
265 the human, animal, and environmental health in the region. These regional efforts also align
266 with strengthening national capacity.³² Recently, RBC joined the Rwanda Agriculture Board
267 (RAB) and other partners to launch the Integrated Disease Surveillance and Response System
268 (IDSR) in the veterinary services.³⁸ This system is designed to improve both human and animal

269 health by enabling timely detection, reporting, and management of diseases, embodying the
270 One Health approach.^{30,32}

271 **Initiatives to strengthen Global Health Security (GHS) Internationally:**

272 RBC is currently leading the implementation of Genomic-enhanced Wastewater Epidemiology
273 (GEWE) as a global early warning surveillance and response system.³⁰ This initiative
274 strategically leverages wastewater and traveller samples from international flights, coupled
275 with advanced genome sequencing technology to monitor the global dynamics of pathogens,
276 including COVID-19 variants (Fig. 1).³⁰ In addition to the initiatives that aim to strengthening
277 the knowledge, production, and provision of vaccines in Africa, RBC is also supporting the
278 hosting of the African Vaccines Manufacturing Accelerator (AVMA) to improve the affordability,
279 accessibility, and sustainable production of vaccines worldwide.³³

280 Rwanda's commitment and leadership in strengthening GHS is further highlighted through
281 RBC, which is entrusted by the Government to lead evidence-based strategic planning and
282 implementation to enhance the quality and coverage of healthcare and public health services
283 in the country. Subsequently, RBC and the Ministry of Health led the international initiative to
284 expand this policy globally, through a convening that led to the Kigali Declaration on Evidence
285 Based Healthcare in Africa (KD-EBHA).^{15,16}

286 Addressing Neglected Tropical Diseases (NTDs) is in the core of RBC's mission. The
287 institution, in collaboration with international partners, aims to eliminate NTDs and reduce their
288 substantial health and socioeconomic burdens, which hinder the development and perpetuate
289 poverty in Africa. In 2022, Rwanda under RBC's leadership, co-led the Kigali Declaration for
290 the Elimination of Neglected Tropical Diseases (KD-NTDs), serving as a global flagship toward
291 achieving the Sustainable Developmental Goals (SDGs).^{39,40} Appreciating that GHS start with
292 health, productive, and integrated community build on safe family environment, RBC and
293 multisectoral partners have committed and signed the Kigali Declaration on the Elimination of
294 Gender Violence (KD-EGV) and Kigali Declaration on Child Care and Protection Reform (KD-

295 CCPR).^{41,42} Recently, in partnership with RBC, in Rwanda 2024 Kigali Declaration on Climate
296 Science for a Sustainable Future for All (KD-CSSFA) was launched to take actions toward
297 climate change with the sustainable development and future strategic planning context (Fig.
298 1).⁴³

299 Through strategic engagement with the leading stakeholders of health and science in addition
300 to several natural characteristics and government investments in making Rwanda attractive
301 and open for the world, this made Rwanda an International Hub for Global Health (IH-GH).⁴⁴
302 This indicated by the rapidly increasing number of high-level events, international conferences,
303 workshop, and training programs as well as regional branches of international institutes and
304 organizations that are frequently or permanently hosted in Kigali (Fig. 1). Furthermore, RBC
305 leadership is a leading member several impactful boards of trustee and international
306 committees that a direct influence on the GHS such as co-chairing International Pathogen
307 Surveillance Network (IPSN) under the WHO pandemic HUB in Berlin and Board Member of
308 the Global Health EDCTP3 Joint Undertaking (Global Health EDCTP3), accordingly the 12th
309 EDCTP Forum in 2025 will be hosted by RBC in Rwanda.⁴⁵

310 **Way forward:**

311 To enhance the implementation of these initiatives and health policies and practices, as well
312 as maximize their impacts on human, animal, and environmental health and sustainability,
313 there is a crucial need for joining all these initiatives and health policies under a single project
314 implementation and coordination mechanism. This will substantially increase the cost-
315 effectiveness, support establishing a robust monitoring and evaluation rubric, and coordinate
316 the efforts, investment, and other engagements of the various stakeholders including the local
317 community and other beneficiaries to empower them and improve their ownership and uptake
318 of interventions. Over years, this was the role and responsibility of the Single Project
319 Implementation Unit (SPIU), however, this unit focus on the national implementation and due
320 to the remarkable growth and diversification of the current initiatives and health practices in
321 response the increasing needs of the growing population, emergence of novel issues and

322 challenges, and narrowed focuses of donors and stakeholders mandates, there is an urgent
323 need for transformation. This transformation should incorporate the use of new technology to
324 integrate different programs and initiatives into digitalized system that is easier to operate,
325 monitor and evaluate. Therefore, the ongoing structure of Regional Pandemic Hub (RPH) in
326 Rwanda is designed and is being established with the vision of bringing all these initiative
327 under a single implementation and coordination mechanism. It will foster collaboration,
328 cooperation, and coordination within the country and between the countries in the region and
329 internationally.

330 **Conclusion:**

331 In conclusion, these ongoing initiatives and others in the pipeline underscore RBC's
332 commitment and dedication to improving GHS at the national, regional, and international
333 levels. For these initiatives to sustainability improve GHS globally, intensified stakeholder
334 engagement is crucial, particularly by empowering at-risk communities to claim ownership and
335 participate in the design and implementation of evidence-based interventions. Additionally,
336 increased investment in expanding Public-Private-Partnerships and leveraging advanced
337 technologies like Artificial Intelligence and machine learning is necessary to develop and
338 implement novel solutions to emerging issues. Improved leadership, resources mobilization
339 and management, and ensuring gender and social equity in care provision and opportunities
340 should be key pillars for the effective improvement of GHS.

341 **Competing Interest:**

342 None to declare.

343 **Data availability statement:**

344 Data are available in a public.

345 **Ethics statements:**

346 **Patient consent for publication:**

347 Not applicable.

348 **Ethics approval:**

349 Not applicable.

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354 experts' consultations, institutional and situational analysis and assessment.

355

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