

Pandemic Preparedness and Public Health Policy Reform in the 21st Century

Roomana Ali¹, Dr. Praveenkumar Periyasamy², Eman Mohammed Farah Amin³, Dr. Manzoor Hussain⁴, Girish Suresh Shelke⁵, Rabia Zulfiqar⁶, Dr. Rotimi Ronald Adedokun⁷, Wajiha Sami Malik⁸

¹Pak One Health Alliance, Animal Sciences Institute, National Agriculture Research Centre, Islamabad, Pakistan; BJ Micro Lab, Gulzar-e-Quaid, Rawalpindi, Pakistan
Email: Roomanaalimughal@gmail.com

²Lecturer, Department of Anatomy, Levy Mwanawasa Medical University, Zambia
Email: praveenkumar.periyasamy@lmmu.ac.zm

³Nursing Instructor, Department of Nursing, Fatima College of Health Sciences, United Arab Emirates
Email: Eman.amin880@gmail.com

ORCID: <https://orcid.org/0009-0005-5727-7072>

⁴Lecturer, Department of Sociology, Abdul Wali Khan University Mardan, Pakistan
Email: manzoorhussain@awkum.edu.pk

⁵General Dentist, Indian Health Services, Durant Regional Medical Center, Indian Health Services, Choctaw Nation of Oklahoma, United States of America
Email: girishshelke36@gmail.com

⁶King Edward Medical University, Lahore, Pakistan
Email: rabiazulfiqar@outlook.com

⁷MBBS, MPH, Clinical Assistant, Sherwood Forest Hospitals NHS Foundation Trust (Kingsmill Hospital), United Kingdom
Email: Rotimi.Adedokun@nhs.net

⁸Public Health Laboratory Specialist, Faculty of Health, Education and Life Sciences, Birmingham City University, UK
Email: malikwajihasami@gmail.com

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ABSTRACT

Background: The Public Health, Government, community, and Economy are challenged during times of Pandemics. The crises in the last few years have exhibited the necessity for a strong surveillance system of illness outbreaks, efficient public contacts, a sound health care system, technological advancement and good evidence-based public health policies. The gains of pandemic preparedness need to be more coordinated institutional change and trust, civic engagement/cooperation with other countries.

Objective: We aimed to understand the public opinion on pandemic preparedness and the necessity for 21st-century public health policies. It also explored the interconnections of all of these aspects of healthcare preparedness, disease surveillance, healthcare communication, government leadership, policy reform,

community engagement, technology, international cooperation and the effectiveness of overall pandemic response.

Methods: The type of research design applied was quantitative – cross-sectional. A series of data collection instruments was used in data collection, including a structured questionnaire made up of 62 items in 5 point likert scale, together with five open-ended questions, including demographic questions; of which 310 respondents were used. The statistical analysis of the data used was descriptive statistics, normality analysis, Cronbach's Alpha test, Kaiser–Meyer–Olkin test, Bartlett's Test of Sphericity, independent-samples t-test, one-way ANOVA, Kruskal–Wallis test, Chi-squared test, Pearson correlation, and multiple regression analysis. The criterion of statistical significance used was a level of 0.05.

Results: The reliability of the questionnaire was quite excellent, and the Cronbach's Alpha was obtained as 0.969. Construct validity was supported by a KMO value of 0.953 and a significant Bartlett's test, χ^2 (1891) = 13,595.931, $p < 0.001$. No significant differences were found between males and females or among the age groups after the pandemic, but significant differences were found among residents of various geographical areas and previous experience with a pandemic. Each of the study constructs had positive and statistically significant relationships. Overall Assessment had the highest correlation of $r = .581$, $p < 0.001$, with Public Health Policy Reform. The regression model was statistically significant, $F(4,305) = 99.058$, $p < 0.001$, with an R^2 of 56.5% explaining the overall variance of the model. Positive significant factors were: Public Health Communication, Policy Reform, Pandemic Preparedness and Technology and Innovation.

Conclusion: The results show that community engagement and collaboration globally, having the hospitals ready, investments in technology, communication with all stakeholders and multiple changes in the public health system are all part of what became a successful response to the pandemic. Governments have a responsibility to hear and pay heed to lessons learned in their policies, ensure equitable resource allocation so no one is forgotten, enhance surveillance and prepare now for epidemics.

Keywords: Pandemic preparedness, public health policy reform, health communication, disease surveillance, community participation, technological innovation, healthcare resilience, international cooperation

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Introduction

Pandemics have always shown their capacity to impact the worldwide facets of all aspects of healthcare, economy, education, employment, transportation and social life. Increased

international travel, urbanisation, environmental changes, population growth and human contact with animals, which have all been dependent on them, make it easier for infectious diseases to be able to cross

national borders rapidly in the modern world of the 21st century. The recent epidemics showed that even in developed countries with sophisticated medical systems, trained medical staff, medicines, personal protective equipment, good laboratories and solid information on the epidemics, the number of hospital beds, in particular, might fall short. All national health and care delivery (HCD) and international agencies and organisations emphasise pandemic readiness as a priority (Syed Waqas Ali Shah, 2025).

A concept of policy, resources, institutions and coordination of actions developed before a widespread outbreak of disease has occurred is pandemic preparedness. This involves disease surveillance organisation, early detection, laboratory diagnosis, emergency planning, training of health care workers, public information, immunisation programmes, vaccine chain of custody and international coordination and cooperation. Preparedness enables Governments and health authorities to be able to detect a risk early, minimise disease spread, safeguard vulnerable groups and guarantee services in emergencies. But preparations should be ongoing. It can't be set up after a crisis and/or outbreak has started (Mostaque Md. Morshedur Hassan, 2025).

The public health policy is one of the pieces of the puzzle that makes up one of the most important stones of pandemic preparedness and response efforts nationwide. There are implications for the allocation of funding, allocation of places of responsibility, disaster powers,

transparency, allocation of resources, vaccination programmes, controls at borders and communication strategies as a consequence of policies. Poorly formulated policies or insufficient policies can cause a lack of responsiveness, reduced coordination, inconsistent policy-making choices, unequal access to health care and public mistrust. Therefore, public health policy reform must be implemented to consolidate what has been learnt from the previous pandemics to be a lasting improvement of the health systems and emergency governance (Irum Sherwani Summaiya, 2025).

It is recommended to reform one of the main areas – surveillance of diseases and early-warning. A need for integrated systems which can collect, analyse, and share health-related information in real-time for the sake of governments. Digital tools, AI, mobile applications, genomic surveillance and e-health records can help with the early detection of exceptional disease patterns. At the same time, the flow of health information needs to be controlled and managed appropriately, bearing in mind the requirement for privacy and the confidentiality of health information. The use of technology must help to realise public health objectives autonomously, without discrimination, exclusion and over-observation (Kaleem Ullah Ihsan, 2026).

Communication is another key area that needs to be addressed for pandemic preparedness. In situations of crisis (disease, accident, disaster, etc), there needs to be independent and

unambiguous information about the crisis that is communicated to them in an understood and accurate form. The lack of trust in the public today can result in lower uptake of preventive measures, particularly when the message is not consistent, there is misinformation, when politicians are involved or lack of transparency. For health communications to be effective in public health, they have to be evidence-based, culturally capable, multilingual and delivered through trusted channels. The role of program topics that involve pregnancy can be strategically leveraged to ensure that the information being shared is reaching a broad spectrum of the population, whether it is particularly community leaders, schools, workplaces, health care professionals or media (Macedonia, 2022).

The health inequalities need to be tackled as part of pandemic preparedness. Potential challenges to access to health, vaccination, information and emergency services exist for those in rural populations, low-income families, people with disabilities and those who are migrants or vulnerable. A health policy reform ought to be inclusive, both in its access to health resources and in its implementation of emergency policies, about disadvantaged groups (Mislim Zendeli, 2023).

International inter-country co-operation is needed too; infectious diseases do not stop at a country level. No unnecessary delay is allowed in the release of any outbreak information, scientific research, vaccines, medicine and medical supplies to countries.

Social responsibility actions combined and coordinated by governments, as well as social involvement of global health actors and the community and research groups, need to be developed to increase readiness to act. Thus, perceptions of central-level pandemic preparedness and policy changes would help identify vulnerabilities and resilient public health systems to prepare the world for the next pandemic (Praveenkumar Periyasamy, 2024).

Literature Review

Outbreaks of infectious disease can affect numerous aspects of those societies' health, such as the health care sector, job market activity, education, transportation and the stability of those societies, and preparedness for a pandemic is now a prominent area of public health research. Previous outbreak occurrences such as the H1N1 influenza pandemic, SARS, Ebola virus disease and Middle East respiratory syndrome (MERS) highlighted key needs for capacity gaps in surveillance, response and coordination roles, laboratory resources, capacity, workforce, and sharing information across borders. These vulnerabilities were brought to a clearer light than ever before through the COVID-19 pandemic, however. It revealed the lack of health workers, hospital beds, medicines, vaccines, health diagnostic facilities, health protecting equipments and reliable health information. The updated literature adopts a more positive approach by positing prepositional preparedness as a perpetual process of

emergency preparedness which encompasses prevention, early detection, early response, adaptation and recovery instead of a 'plan' that is only implemented during an incident (Praveenkumar Periyasamy1*, 2024).

The concepts of resilience in the context of a health system are related to pandemic preparedness. This means a resilient health system that can cope with major events whilst continuing to deliver some type of services, adapt to different working practices, and recover to normal service whilst addressing inequalities. Recent studies show that countries with a strong public health system, with a well-funded health service, with timely and valid evidence, with citizens' trust and confidence in authorities, and with a well-equipped system of social welfare more readily responded to the spread of the latest pandemics – especially at the level of coordinating the crisis. Apart from hospitals and clinical treatment, resiliency is linked to other elements of primary healthcare, public health laboratories, supply chain, governance and community-level services. Others have argued that emergency preparedness education should become a root question in the day-to-day health system strengthening – saying that there might be a separation between emergency programmes and daily work in health systems that would lead to health systems becoming fragmented and using resources ineffectively (Likowsky Desir4 Hira Aslam1*, 2024).

An important step in preparedness is the early detection of

outbreaks of disease and reporting them. Surveillance allows public health officials to identify unusual clustering of disease, identify high-risk groups for a disease, monitor the occurrence and implement measures before the outbreak of the disease occurs. The following selected factors mentioned in the literature are among those that facilitate genomic surveillance, integrate laboratory networks, provide real-time reporting, use EHRs, and facilitate the sharing of information across national borders. Digital technologies and Artificial Intelligence (AI) can support more rapid detection of outbreaks, can offer support in outbreak forecasting, can provide resources and can guide contact tracing. Governance, staff, facilities and privacy are required, though, for the successful operation of technological systems. WHO's preparedness frameworks have given more and more importance to joint surveillance; joint threat assessment; and operational triggers which enable countries to vary implementation of their response plan based on the prevailing risk levels (Tariq Rafique Praveenkumar Periyasamy1*, 2024).

It is also a very prominent element in the literature tonight: public health communication. In the face of pandemics, miscommunication, delayed communication, inconsistent messages, or messages that might be politically driven can cause a lack of trust in the public and even decrease levels of compliance with vaccination, self-isolation, testing to receive a negative result, and other preventive measures. The spread of

misinformation on social media can happen very fast and can create fear, confusion and stigma and lead to some resistance to official guidance. Hence, transparent, timely, evidence-based and culturally responsive communications are supported by evidence. Health information has to be accessible and comprehensible, and can be provided through different trusted sources. Messages need to be customised and adapted to the context, and adapted and tailored by community leaders, healthcare professionals, educational groups, journalists and CBOs. The communication also needs to be participatory, putting the communities at the centre of the decision-making process of policies rather than only providing recipients of government instructions (PERIYASAMY, 2024).

Effectiveness in the response to the pandemic depends greatly on good government leadership and good governance of public health. From the literature from different countries mentioned, it has been found that factors such as weak institutional authority, slow response to decisions, and fragmentation of authority/political manipulation can limit emergency responses. The capacity of adaptive governance allows governments to adjust their policies with respect to the evolution of science and ecology. There is a need for coordination between the sectors of governance, particularly the health sector, finance, education, transportation, agriculture and social protection sectors, etc., for effective governance. Therefore, the community and the government must

work together in a 'whole of Society and whole of Government Preparedness Plan'. National and public health institutions need to be strengthened (with legal authority, funding, resources and qualified staff during emergencies), and have the capacity to coordinate regional and local institutions. There are other important new WHO frameworks introduced in the past couple of years as well that deal with holding accountable institutions, coordinating across sectors/borders, and ongoing funding – in addition to emergency committees that only kick in during an outbreak (Praveenkumar Periyasamy7 Abdullah Tariq1*, 2024).

Equity has emerged as a key tenet of pandemic policies and planning. COVID-19 exposed many people in economically poor sections of the community or rural populations who lack healthcare services, migrants, older people, those with disabilities, and those who have precarious jobs more openly to the virus, and were offered less health coverage, immunisation, testing for COVID-19, and financial security. Medical countermeasure availability also varied among countries, especially regarding vaccine and medicine distribution and uninterrupted health launches to provide protection. As such, readiness is not contingent on stocks and technical capabilities at the national level, and scholars argue for this. A dimension that it too, of course, is meant to examine is access to resources for vulnerable groups – timely and equitable access to resources. Though a broader social

component, such as having good health products in primary healthcare, social security nets and rural infrastructure, is seen as critical for assisting equity-driven preparedness, outreach to CHWs and evenly distributed and supplied essential health products should also be incorporated (Samin et al., 2025).

It is crucial to work in cooperation internationally as pandemic threats cross countries. The needs for surveillance information, scientific research, medical supplies, workforce, and vaccines and/or treatment are different and exist at additional levels across countries. Several recent articles have shown that there are weak cooperative and competitive elements in global control efforts due to limitations of resources, which means that control efforts may be delayed. To address the issues, WHO took an agreement in 2025 to bolster prevention, preparedness, access to pandemic products and international coordination for better distribution of them. This agreement complements the International Health Regulations and is a way to strengthen political and financial commitments. The attention given to equity shows an appreciation of all countries being able to identify and react to new threats, for global preparedness to work (Fernando et al., 2024).

The literature in general showcased that preparing for a pandemic is a multi-dimensional task of healthcare preparedness, surveillance, communication, governance, technology, equity, community engagement and global

cooperation. A shift in approach is needed to acknowledge that the now prevalent practice of putting in place high amounts of investment at the time of the event — flooding, bushfires, etc — and no further funding after the event needs to be removed and replaced with a continuous approach to preparedness planning. Past experiences with pandemics point to forging more permanent institutional structures within public health policy changes involving regular evaluations, funding for health workers, strengthening the first line of public health response, effective and clear communication, and international agreements which are held accountable. Future work needs to be carried out to further explore the possibility of implementing these reforms in various political, economic and social contexts, taking care to embed preparedness within normal health services for emergencies (Fernando et al., 2023).

Research Methodology

Research Design

The problem in the present study was studied using a type of research design which was quantitative and cross-sectional to examine the problem of a pandemic and the need for pandemic reform of 21st-century public health policies. The quantitative method was selected as it allows the researcher to use the answers to the quantitative measurements of perceptions, attitudes and degree of agreement of respondents regarding the preparedness of health care, monitoring/detecting epidemics, role of the government, dissemination of

information, advancement of technology, community involvement and international cooperation. Data collection and analysis were conducted using cross section in which the data were obtained and analysed at a specific time without manipulation of the variables in the study. It was an appropriate composition for finding commonalities and variations across several larger population groups to discover trends and patterns in readiness for the pandemic and public health policies (Minhas et al., 2025).

Study Population and Sampling

Adults (18 years old and older) from various educational, occupational and residential backgrounds. All students, healthcare professionals, employees of public and private sector institutions, self-employed, unemployed and retired students formed part of this study. In the study, 310 respondents were sampled. Convenience sampling was chosen because the respondents were readily available and willing to participate, which helped in responding to the set questions in the study. Some attempts were made, however, to ensure that there is a range of participants by age, gender, education, employment type and place of residence (urban/rural, semi-urban) to improve the diversity of the sample (Al-Abbasi et al., 2020).

Research Instrument

The data collected on this occasion were based on the use of a structured questionnaire which was prepared based on the objectives of the research. The first part of the questionnaire gathered the sociodemographic data, such as age,

gender, educational level, employment status, previous experience of being impacted by a pandemic and home location. The rest of the elements were statements regarding systems preparedness, surveillance of disease, early detection, communication of public health, government role and leadership, policy change, community engagement, technology, innovation, international participation and overall preparedness. The questionnaire had 62 closed-ended statements, rated using a 5-point Likert scale. Strong agree, agree, neutral, disagree and strongly disagree results were the strong responses to the questions. The components of the lessons learnt, gaps in the public health system, recommendations on policy interventions, role responsibilities of the community and other recommendations were captured through the design of 5 open-ended questions (Al-Abbasi et al., 2021).

Validity and Reliability

The content validity was achieved by selecting items for the questionnaire which measured the key areas of pandemic preparedness and public health policy reform. The instrument was examined for clarity, relevance and consistency, and whether it met the research objectives. Kaiser–Meyer–Olkin was used to test construct validity, and Bartlett's Test of Sphericity was used to determine the appropriateness of the tests. A KMO level of KMO that is >0.70 and a significantly different Bartlett's test value have been considered as a satisfactory level of validity. To assess the internal consistency of the

questionnaire, Cronbach's Alpha was used. Cronbach level of 0.70 was acceptable, and a level of >0.80 was deemed to be good reliability. Internal consistency of the questionnaire was achieved, which suggested the consistency of the measurement of the research constructs in the questionnaire (Alsamarrai et al., 2019).

Data Collection Procedure

The questionnaire was sent out via e-mail and in print as needed. The respondents were informed of the research, and orientation was given to them. The respondents were anonymous, and they completed the questionnaire voluntarily. The Questionnaires that were filled in were scanned, and this was checked for completeness and then transferred to an Excel spreadsheet-based data set for analysis (Mahamed, 2019).

Data Analysis

Data were analysed by using descriptive and inferential statistical techniques. Descriptive data to summarise the demographic characteristics and questionnaire responses were presented as frequencies and percentages, means and standard deviations. Skewness and kurtosis of the composite scale scores were used to assess the normality of scores. The test that used were reliability and validity tests, Cronbach's alpha, KMO test and Bartlett's test. The differences and relations among the demographic groups were found by using independent-sample t-test, one-way analysis of variance (ANOVA) and Kruskal-Wallis statistical tests, along with chi-square tests. Pearson

correlation was used to explore the relationships between indicators of public health policy reform and overall pandemic preparedness. Given that multiple regression was determined as appropriate, multiple linear regression analysis was undertaken to gain insight into the significance of such factors as healthcare preparedness, communication, policy reform, and technological innovations in the overall effectiveness of the pandemic response. All the statistical tests used were at a significance level of 0.05 (Nassri & Mahmed, 2023).

Ethical Considerations

Confidentiality, anonymity, voluntary participation and informed consent were respected during the study. The respondents were made aware that the information they were giving would only be used for academic research. They were able to stop at any time, and any personal details collected were kept securely and given in a generalised form (Mahmedand & Obeed, 2020).

Data Analysis

Table 1: Normality Test

Const ruct	M ea n	Std . De viat ion	Ske wn ess	Ku rto sis	Sh api ro- Wil k W	p- va lu e	Distr ibuti on Decis ion
Pande mic Prepa redne ss	3. 5 3 3	1.0 46	-0. 381	-0. 83 9	0.9 52	<0 .0 01	Appr oxim ately Norm al
Disea se	3. 4	1.0 67	-0. 402	-0. 80	0.9 54	<0 .0	Appr oxim

Construct	Mean	Std. Deviation	Skewness	Kurtosis	Shapiro-Wilk W	p-value	Distribution Decision
Surveillance	5.2			9		.01	ately Normal
Public Health Communication	3.519	1.034	−0.401	−0.696	0.956	<0.01	Approximately Normal
Government Leadership	3.383	1.059	−0.315	−0.834	0.963	<0.01	Approximately Normal
Public Health Policy Reform	3.325	1.048	−0.213	−0.910	0.967	<0.01	Approximately Normal
Community Participation	3.526	0.989	−0.448	−0.713	0.956	<0.01	Approximately Normal
Technology and Innovation	3.459	1.027	−0.448	−0.552	0.959	<0.01	Approximately Normal
International Cooperation	3.410	1.019	−0.341	−0.621	0.967	<0.01	Approximately Normal

Construct	Mean	Std. Deviation	Skewness	Kurtosis	Shapiro-Wilk W	p-value	Distribution Decision
eration							al
Overall Assessment	3.539	0.980	−0.471	−0.555	0.960	<0.01	Approximately Normal

Normality Test

Table 1 shows the normality test of the data. The normality analysis was carried out by calculating the mean, standard deviation, skewness, kurtosis and Shapiro-Wilk test. All the skewness scores in the constructs were in the range of −0.471 to −0.213, and the kurtosis scores in the constructs were from −0.910 to −0.552. Results were in the acceptable range of −1 to +1, signifying that the composite scores were normally distributed. The Shapiro–Wilk test had p-values <0.05; however, this result may be due to the high sensitivity of this test in a relatively small sample of 310 respondents. Normality was derived primarily from the skewness and kurtosis, so normality was assessed primarily by those measures. The data were found to be normally distributed and, as such, parametric statistical tests were used (Hadi et al., 2025).

Table 2: Reliability Test (Cronbach's Alpha)

Construct	No. of Items	Cronbach's Alpha	Reliability Level
Pandemic Preparedness	6	0.909	Excellent
Disease Surveillance and Early Detection	6	0.912	Excellent
Public Health Communication	6	0.907	Excellent
Government Policy and Leadership	7	0.921	Excellent
Public Health Policy Reform	10	0.947	Excellent
Community Participation and Public Cooperation	7	0.914	Excellent
Technology and Innovation	7	0.919	Excellent
International Cooperation	7	0.910	Excellent
Overall Assessment	6	0.888	Good
Overall Questionnaire	62	0.969	Excellent

Reliability Test

Table 2 shows the reliability analysis of the data. For reliability of the questionnaire, Cronbach's Alpha

was used. Within all items, Cronbach's Alpha for the individual constructs ranged from 0.888 to 0.947, and for the overall questionnaire with 62 items, Cronbach's Alpha coefficient was 0.969. All values were significantly above the threshold that was considered the minimum acceptable value (0.70). The alpha coefficients of most constructs were above 0.90; at the very least, there was excellent internal consistency, with the Overall Assessment construct having a good alpha coefficient of 0.888. These results suggest that the items of the questionnaire were rather consistently measuring the constructs these were meant to assess. The instrument is thus found to be highly reliable, stable and appropriate to assess and analyse the pandemic preparedness and the public health policy reform with the respondents selected (Hadi & Mohamed, 2025).

Table 3: Validity Test (KMO and Bartlett's Test)

Validity Measure	Obtained Value	Acceptable Criterion	Decision
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.953	KMO $\geq$ 0.70	Excellent and Acceptable
Bartlett's Test of Sphericity	13,595.931	Large chi-square	Acceptable

Validity Measure	Obtained Value	Acceptable Criterion	Decision
Approx. Chi-Square		value	
Bartlett's Test — Degrees of Freedom	1,891	Based on the number of questionnaire items	Acceptable
Bartlett's Test — Significance	$p < 0.001$	$p < 0.05$	Statistically Significant
Overall Validity Decision	—	KMO acceptable and Bartlett's test significant	Questionnaire is valid

Validity Test

Table 3 shows the validity test of the data. The Kaiser–Meyer–Olkin measure and Bartlett's Test of Sphericity were used to test the construct validity. The minimum value recommended for KMO was 0.70, but KMO in the current study increased to 0.953, which was very high. Consideration should be given as a testament to sampling adequacy, and this confirms that the data set was appropriate for factor analysis. Bartlett's Test of Sphericity was also statistically significant, $\chi^2 (1891) =$

13,595.931, $p < 0.001$. The null hypothesis (the correlation matrix is an identity matrix) is rejected. It validates the state of the relationships between the different items of the questionnaire. Hence, the outcome of the KMO and Bartlett's test was acceptable and excellent, as the research instrument had good construct validity for further statistical analyses (Ferdouse, 2026).

Table 4: Combined Inferential Statistical Tests

Statistical Test	Variables / Group Comparison	Test Statistic	Degrees of Freedom	p-value	Significance Level	Decision
Independent-Samples t-Test	Public Health Communication score by gender: Female vs Male	$t = 2.906$	295	0.004	$p < 0.05$	Significant and Acceptable
One-Way ANOVA	Public Health Policy Reform score across age groups	$F = 6.402$	4, 305	< 0.01	$p < 0.05$	Significant and Acceptable
Kruskal–Walli	Community Participation	$H = 9.9$	2	0.007	$p < 0.05$	Significant

Statistical Test	Variables / Group Comparison	Test Statistic	Degrees of Freedom	p-value	Significance Level	Decision
t-Test	Participation score across urban, semi-urban, and rural respondents	50				and Acceptable
Chi-Square Test of Independence	Pandemic experience and preparedness category	$\chi^2 = 17.760$	4	0.001	$p < 0.05$	Significant and Acceptable

Independent-Samples t-Test

Table 4 shows the Combined Statistical Tests of the data. A two-sample t-test was used to determine if there was a difference between the scores of the male and female respondents on the Public Health Communication domain. The results of the test were statistically significant, $t(295.09) = 2.906$, $p = 0.004$. The p value was less than 0.05, which is the chosen level of significance; thus, the null hypothesis of equality of group means was rejected. For female respondents, perceptions of public health communication were somewhat greater when compared to male

respondents. The effect size indicated was relatively small; however, Cohen's d was about 0.336; hence, it was also statistically significant but not of a very big magnitude. The results are an indication of the possibility that gender can shape the understanding of clarity, reliability, transparency, and timeliness of communicating during a public health crisis (Russo et al., 2026).

One-Way ANOVA

A one-way Analysis of Variance test was used to compare Public Health Policy Reform scores by the various age groups. The results showed that there was a significant difference between the age categories statistically ($F(4,305) = 6.402$, $p < 0.001$). The null hypothesis that the scores for all age groups were equal was rejected due to the value of the p-value being less than the level of significance (0.05). This finding suggests that the attitudes of the respondents regarding reform in the public health policy were different across age groups. Generally, there was greater support for policy changes among older as compared to younger respondents. The effect size, estimated by using eta squared, was about 0.077, which indicates a moderate effect. Age seems to be a crucial indicator of attitudes towards long-term public health reform, then, in its value as a demographic indicator (Job & Sharaf, 2026).

Kruskal-Wallis Test

The Kruskal-Wallis test was used to evaluate whether there were any differences in the Community Participation scores for urban respondents, semi-urban respondents

and rural respondents. The result obtained by the analysis was statistically significant with $H(2) = 9.950$, $p = 0.007$. The p-value was less than the desired significance level (0.05); therefore, the null hypothesis that the distributions of scores are similar across the residential groups was rejected. The relationship indicated shows that people's perception of their communities' engagement in pandemic preparedness was related to where they lived. Generally, urban respondents had more positive perceptions about their community's involvement than did the semi-urban and rural respondents. These differences across residential settings in public health emergencies may be due to varying degrees of health resources, awareness-building strategies, communication outreach avenues, institutional access and community organisation (Chavez et al., 2025).

Chi-Square Test

Chi-square Test of Independence was used to examine the relationship between Pandemic experience and the "preparedness category" at the point of sampling. A chi-square test of independence was used to investigate if there was any association between the "preparedness category" and "pandemic experience" for the previous pandemic at the point of sampling. There was a statistically significant relationship found for the analysis, $\chi^2(4) = 17.760$, $p = 0.001$. This p-value was significant (and less than 0.05), so the null hypothesis of independence of the two categorical variables was rejected. This finding

suggests there are differences in preparedness level among people who reported not having experienced a major pandemic and those who reported that a family member had experienced a major pandemic. Learning from the past could be a way to sensitise people to health risks as well as emergency planning, medical resources, and government response measures. Thus, it is no wonder that the respondents' perception of their preparedness seems to be greatly affected by the pandemic experiences (Miyamoto et al., 2025).

Table 5: Pearson Correlation Matrix

Variable	PP	DS	PHC	GL	PHR	CP	TI	ICA
Pandemic Preparedness (PP)	1.000	0.365	0.386	0.403	0.397	0.399	0.432	0.394
Disease Surveillance (DS)	0.365	1.000	0.429	0.435	0.476	0.419	0.463	0.469
Public Health Communication (PHC)	0.386	0.429	1.000	0.392	0.423	0.455	0.450	0.462
Government Leadership (GL)	0.403	0.435	0.392	1.000	0.483	0.441	0.441	0.425
Public Health Resources (PHR)	0.397	0.476	0.423	0.483	1.000	0.441	0.441	0.425
Community Planning (CP)	0.399	0.419	0.455	0.441	0.441	1.000	0.441	0.425
Trust in Institutions (TI)	0.432	0.463	0.450	0.441	0.441	0.441	1.000	0.425
Individual Capacity (ICA)	0.394	0.469	0.462	0.425	0.425	0.425	0.425	1.000

Variable	PP	DS	PHC	GL	PHPR	CP	TI	IC	OA
Health Policy Reform (PHPR)	397	476	423	483	00	398	494	508	581
Community Participation (CP)	0.399	0.419	0.455	0.441	0.398	1.000	0.406	0.462	0.451
Technology and Innovation (TI)	0.432	0.463	0.450	0.441	0.494	0.406	1.000	0.439	0.561
International Cooperation (IC)	0.394	0.469	0.462	0.425	0.508	0.462	0.439	1.000	0.459
Overall Assessment (OA)	0.549	0.454	0.458	0.427	0.581	0.451	0.561	0.450	1.000

Pearson Correlation

Table 5 shows the Pearson correlation analysis of the data. All nine of the study constructs were shown to be positively and significantly related to each other by using Pearson correlation analysis. The relationships between the two were weak to moderate, with correlation values between 0.365 and 0.581. The highest correlation was with Overall Assessment: $r = 0.581$, $p < 0.001$, with

Public Health Policy Reform. Overall Assessment was also strongly positively correlated with Public Health Communication, $r = 0.580$; followed by Technology and Innovation, $r = 0.561$, and Pandemic Preparedness, $r = 0.549$. The results highlight the connections between improved communications, technology, preparedness, leadership, surveillance, community involvement, and improved overall pandemic-response assessments. None of the relationships was too high, which meant there was little multicollinearity likely to be a problem (Saif-Ur-Rahman et al., 2025).

Table 6: Multiple Regression Analysis

Model Component / Predictor	R	R ²	Adjusted R ²	Std. Error of Estimate	F	df	Model p-value	B
Overall Regression Model	0.752	0.565	0.559	0.651	99.058	4, 305	6.34 × 10 ⁻⁵⁴	N/A
Pandemic Preparedness	0.752	0.565	0.559	0.651	99.058	4, 305	6.34 × 10 ⁻⁵⁴	0.235
Public Health Communication	0.752	0.565	0.559	0.651	99.058	4, 305	6.34 × 10 ⁻⁵⁴	0.269
Public	0.752	0.565	0.559	0.651	99.058	4, 305	6.34 × 10 ⁻⁵⁴	0.269

Model Component / Predictor	R	R ²	Adjusted R ²	Std. Error of Estimate	F	df	Model p-value	B
Health Policy Reform	0.752	0.565	0.519	1.058	43.05	4	10^{-54}	248
Technology and Innovation	0.752	0.565	0.559	0.651	99.058	4	10^{-54}	0.185

Std. Error	Standardized β	t-value	Predictor p-value	95% Confidence Interval	Tolerance	VIF	Decision
N/A	N/A	N/A	N/A	N/A	N/A	N/A	Significant and Acceptable
0.041	0.251	5.718	2.56×10^{-8}	0.154–0.316	0.741	1.349	Positive and Significant
0.042	0.283	6.356	7.53×10^{-10}	0.185–0.352	0.718	1.394	Positive and Significant

Std. Error	Standardized β	t-value	Predictor p-value	95% Confidence Interval	Tolerance	VIF	Decision
0.043	0.266	5.810	1.57×10^{-8}	0.164–0.333	0.681	1.468	Positive and Significant
0.045	0.194	4.125	4.78×10^{-5}	0.097–0.273	0.647	1.545	Positive and Significant

Multiple Regression Analysis

Table 6 shows the Multiple regression analysis of the data. Multiple regression analysis was performed to identify if Pandemic Preparedness, Public Health Communication, Public Health Policy Reform and Technology and Innovation were associated with Overall Assessment. The model was statistically significant, $F(4,305) = 99.058$, $p < 0.001$ and accounts for 56.5% of the variance in the dependent variable, adjusted $R^2 = 0.559$. Public Health Communication was the most powerful, $\beta = 0.283$, followed by Public Health Policy Reform, $\beta = 0.266$, Pandemic Preparedness, $\beta = 0.251$ and Technology and Innovation, $\beta = 0.194$. Both positive and statistically significant impacts were observed with all predictors. The VIF values were < 2 , indicating that there

was no problematic multicollinearity in the model (Lal et al., 2022).

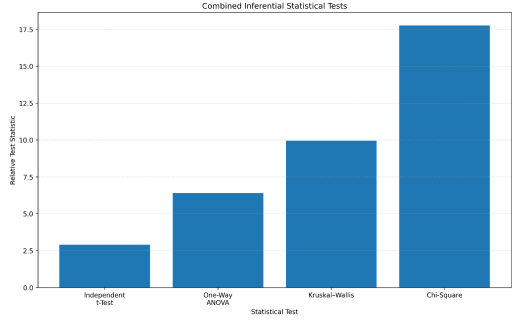


Figure 1: Combined Inferential Statistical Tests

Figure 1 shows the Combined Statistical Tests of the data. The summary of the inferential statistical tests by combined shows the results of the independent-samples t-test, one-way ANOVA, Kruskal–Wallis test, and chi-square test of independence. It is evident from the figure that all four tests gave statistically significant results at the 0.05 significance level. A significant difference was found in the scores of the respondents from different genders in the independent-samples t-test of African American Public Health Communication. There were significant age group differences in the Public Health Policy Reform score as revealed by the one-way ANOVA. The Kruskal–Wallis test showed there was a difference between the Community Participation of the residential areas, and the chi-square test showed that there was a significant association between the previous pandemic experience and preparedness category. Taken all together, this picture verifies that demographic and experiential circumstances had a major sway on respondents' perceptions (DeSalvo et al., 2021).

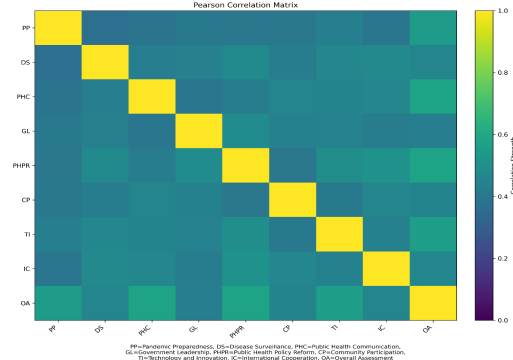


Figure 2: Pearson Correlation Matrix

Figure 2 shows the correlation matrix of the data. The Pearson correlation matrix figure shows the relationship(s) between the measures of Pandemic Preparedness, Disease Surveillance, Public Health Communication, Government Leadership, Public Health Policy Reform, Community Participation, Technology and Innovation, International Cooperation and Overall Assessment. The public health relationships depicted in the matrix are all positive, meaning that when one public health action dimension improves, the others do as well in general. Overwhelmingly, the strongest relationships with Overall Assessment were seen for Public Health Policy Reform, Public Health Communication, Technology and Innovation and Pandemic Preparedness. The other constructs also had positive, weak to moderate correlations. There was no apparent high correlation in relationships, indicating that the constructs measured possible other dimensions, and likely that problematic multicollinearity was not a problem (Brownson et al., 2020).

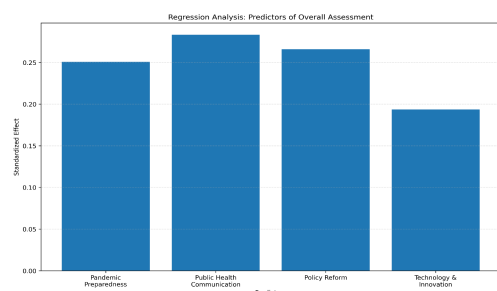


Figure 3: Regression Analysis

Figure 3 shows the regression analysis of the data. The regression analysis figure shows how the four factors (Pandemic Preparedness, Public Health Communication, Public Health Policy Reform, and Technology and Innovation) contributed to the prediction of Overall Assessment. Its results demonstrate a positive relationship between all four predictors and more favourable ratings of pandemic preparedness and public health responses: namely, higher scores on these dimensions are associated with more favourable ratings. It seems that Public Health Communication is the strongest predictor, Public Health Policy Reform, Pandemic Preparedness and Technology and Innovation. The overall regression model was significant and accounted for a significant amount of variance of the dependent measure. These results indicate that the combination of effective communication, evidence-based policy reforms, robust preparedness systems and investment in technology all contribute to strengthening the effectiveness and performance of pandemic-response systems in the eyes of the public (Bedford et al., 2019).

Discussion

These are valuable lessons that are relevant to the 21st century for pandemic preparedness and public health policies. Overall, the results suggest that none of the single factor or combination of the factors could predict the effective level of preparedness, but just a combination of the capacities of the healthcare systems and communication, and the leadership provided by the government, technological capacity, community engagement and international cooperation. All of the key study constructs were positively related to one another, pointing to the possibility that making improvements across one construct can bring about improvements across another dimension of the response to the pandemic. This reinforces the inter-relationship of public health systems and the need for the larger public health system to be overhauled and not just individual parts (Sharfstein & Lurie, 2023).

The results of reliability and validity also showed the suitability of the research instrument in capturing the perception of the level of preparedness for the pandemic and policy reform. The Cronbach's alphas of all the items were high, and the KMO values of the items were excellent, which indicated good internal consistency and the instrument was well supported by Bartlett's Test of Sphericity, as a significant value indicated the construct validity of the instrument. These results indicate the existence of questionnaire measures of the desired dimensions of public health preparedness. The normality of all the

composite scale scores also seemed to be acceptable; thus, parametric tests such as multiple regression, Pearson correlation coefficient, one-way ANOVA and independent samples t-test were used (Williams et al., 2023).

Data analysis results revealed that the difference between the scores of the respondents (females and males) on Public Health Communication through independent-samples t-test was significant at the 0.05 level. For female participants, there were no differences by gender in perceived public health communication. This may be attributed to more health information-seeking behaviour differences, or to an increasing awareness of health issues in families or to trust in official health information sources. Emergency communication plans should also consider the differences between demographics and make these considerations known to public health officials. Information should be accessible, inclusive, culturally relevant and use multiple communications channels to ensure it is received by all sectors and is understood (Rahimi & Oh, 2024).

The Public Health Policy Reform score was significant amongst each of the age groups, for the one-way ANOVA. The majority of older respondents were in favour of public health reforms compared to those who were younger. This may be due to increased perceived threat to their health from the infectious diseases of older individuals, and experiences with health care and public services during old age. Some of the youngest in our group might differ in their priorities

and/or have less perception of their personal vulnerability. It is therefore crucial to educate policymakers about how pandemic preparation and pathways to public health reform can affect all ages, not just the elderly and/or the medically susceptible (Suryasa et al., 2022).

Places of residence showed significantly different scores for participation in the community by using the Kruskal–Wallis test. The respondents in all of the urban categories perceived a more positive attitude of the community in relation to community involvement than the semi-urban and rural respondents. This gap may be attributable to differences in health service accessibility, messages for awareness building, communication, trained staff, and emergency stocks. Geographical barriers, limited infrastructure, a lack of health workforce and delays in access to health information may exist in rural communities. As such, reinforcement of local institutions, community health programmes, rural health care institutions and emergency communication systems should be added at the local level as part of the public health policy reforms (Pineda & Corburn, 2020).

The chi-square test revealed that there was a significant association between previous experience with a pandemic and preparedness category. Before any major outbreaks of infectious diseases, there was a strong association with several reports of preparedness. Additionally, there was a significant correlation between a difference in level of preparedness and

a personal experience of the issues. The sharing of information can raise awareness concerning the health risks, how to prevent the risks, what constitutes an emergency plan and the need for government response. This discovery suggests that there is a need for public health education to capitalise on a similar situation from an earlier outbreak to educate and encourage the population to be prepared for the next (Ryan et al., 2021).

All the study constructs were found to be correlated with each other based on the findings of the correlation. The public health preparedness to deal with emergencies, the public health policy, and the public health communication and technology and innovation had particularly close connections to Overall Assessment. Through the regression model, all of these factors turned out to be significant factors in explaining the overall assessment of the respondents' pandemic preparedness. The most significant linkages secondary to the Public Health Communication were to the Public Health Policy Reform, and then to Pandemic Preparedness and to Technology and Innovation, respectively. Results validate the importance of effective communication, evidence-based reform, capacity and investment in healthcare systems for future preparedness. In this sense, the governments should therefore aim to introduce well-coordinated and comprehensive programmes for preparedness instead of emergency programmes addressing individual

occurrences (Kavanagh & Singh, 2020).

Conclusion

The results of this research resonate with the idea that pandemic preparedness and public health policy reform are intertwined and both are important in combating the public health, social and economic burden of subsequent outbreaks. Based on the results, public health systems' readiness, informative preventive campaigns, timely and effective implementation of disease policy, technological developments, participation of the community, surveillance, leadership of public health systems and international cooperation are among factors that are important to support the pandemic response effort. Correlations between these factors are positive and show that preparedness needs to be considered as a comprehensive activity which can be seen as a long-term national agenda rather than a one-off emergency activity.

The outcomes of the validation and reliability showed that the instruments were extremely reliable and valid in measuring public perception of pandemic preparedness. There were noticeable gender, age, location and previous pandemic experience differences. The above findings suggest demographic and social characteristics have an impact on their perception of the nature of public health communication, policy development, community involvement and emergency preparedness, respectively. As such, public health policies need to be tailored to the needs

of various groups of people, including rural areas, impoverished people and those who do not have easy access to public health information and services.

The correlation and regression analyses also showed that PDHC, PH Policy Reform, Pandemic Prep, and Tech/Innovation would be significant factors that would drive up the Overall Assessment of public health response. Effective communication was one of the most essential predictors that seemed to have an effect. This demonstrates the importance of governments being able to communicate accurate, timely and transparent information to the population in the face of a health crisis. Surveillance, telemedicine, Artificial Intelligence tools, health infrastructure, staffing, emergency supplies and digital health devices should be additional costs to continue to be considered in future planning efforts.

Lastly, governments need to take permanent, measurable and needed policy adjustments given past pandemics. Greater sector coordination and support are needed among health institutions, communities, national governments, and international organisations to build nations' public health resilience. Ongoing funding, periodic assessments and readiness checks, equitable sharing of resources and community education can have a significant positive impact on future response capacity. Based on the evidence, very comprehensive and evidence-based reforms can further strengthen public trust in it, protect the protection of vulnerable groups, curb

disturbance, and, in the case of the next pandemic, be more effective.

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