*Ajit More, Swapnil Thorat, Swati Desai, Ramchandra Vasant Mahadik, Gandhali Vijay Kharge, Deepti Deshmukh, Measuring Efficiency and Effectiveness in Public Health Management: Methodologies and Applications.*
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# Measuring Efficiency and Effectiveness in Public Health Management: Methodologies and Applications

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**ABSTRACT**

Efficient and successful measures are important for judging how well public health management systems work. To find out how efficient and effective public health management is, this study work looks at different methods and uses. Starting with a definition of efficiency and effectiveness in public health, highlighting how important they are for making the best use of resources and getting desired health results. For example, data envelopment analysis (DEA), stochastic frontier analysis (SFA), cost-effectiveness analysis (CEA), quality-adjusted life years (QALYs), and other related methods are used to measure these measurements. Furthermore, the essay talks about the problems and limits of figuring out how efficient and effective public health management

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is, including the lack of data, its poor quality, and the complexity of healthcare systems. Lastly, it shows how these methods have been used in the real world to review and improve public health management practices. This shows how important they are for helping make policy decisions and developing strategies for allocating resources.

## 1. INTRODUCTION

In the field of public health management, figuring out how well healthcare systems, programs, and policies work depends on how efficient and effective they are. People often use these terms to refer to the same thing, but they actually refer to different parts of healthcare service. Efficiency means making the best use of resources to get the health results you want, with the goal of minimizing waste and increasing production. Effectiveness, on the other hand, measures how well healthcare treatments improve people's health. Both speed and effectiveness give us important information about how well and what kind of effect public health efforts have on the world as a whole. You can't say enough about how important it is for public health management to measure speed and success. When there aren't enough resources and different needs, people making decisions have to decide which actions are most important and where to put resources to get the most help. The [1] general reach and effect of public health programs are increased when resources are used efficiently. This makes the most of restricted funds and staff to reach as many people as possible. Evaluating efficiency also lets people involved know how well treatments are doing at getting the health results that are wanted. This makes it easier to make decisions based on facts and improve quality all the time. The goal of this study paper is to look into different ways and uses of measuring how efficient and effective public health management is. The paper looks at different quantitative and qualitative methods, as well as real-life case studies, to show how these measures are evaluated, understood, and used to help make policy choices and plan how to distribute resources [2].

There are a [3] lot of different ways to figure out how efficient and good public health management is. By comparing inputs and outputs, quantitative methods like Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) can be used to figure out how efficient healthcare facilities and programs are. It can figure out how valuable an action is by comparing its prices to the health benefits it brings. This is called cost-effectiveness analysis (CEA). Quality-adjusted Life Years (QALYs) are a complete way to measure health results because they take into account both the amount and quality of life gained from treatments. Case studies and program reviews are two examples of qualitative research methods that can help us understand how well public health projects work and what makes them succeed or fail.

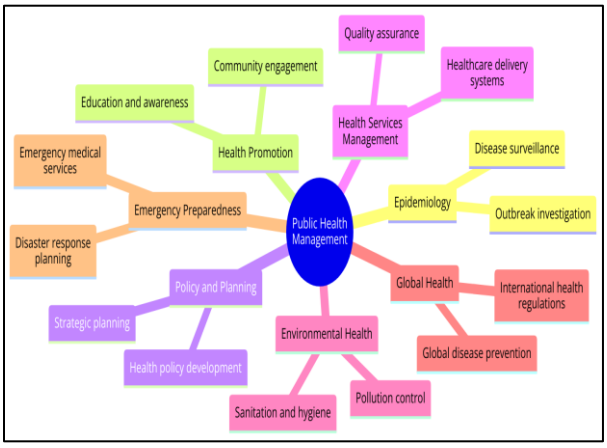


Figure 1: Taxonomy of Public Health Management

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However, it can be hard and has some limits to figure out how to measure speed and success in public health management. Data quality and access are big problems when it comes to reliable measuring, especially in places with few resources and health information systems that aren't fully developed. It [4] is harder to judge success in healthcare systems because they have many partners, different ways of providing services, and outside factors that affect them. Furthermore, the multidisciplinary nature of public health necessitates cooperation between different fields and areas, which makes measurement and analysis even more difficult. Even with these problems, it is still very important to measure how efficient and effective public health management is. Real-life examples and case studies show that these measures can help with making policy decisions, allocating resources more efficiently, and improving the health of a community. Stakeholders can make these measures more useful and reliable for driving positive change in public health management by solving research issues, taking advantage of new tools, and encouraging teamwork between different fields [5].

## 2. METHODOLOGIES FOR MEASURING EFFICIENCY AND EFFECTIVENESS

In public health management, efficiency and success are complex ideas that need a wide range of monitoring methods. This part talks about some numeric and qualitative methods that are used to evaluate these important measures.

### 2.1 Data Envelopment Analysis (DEA)

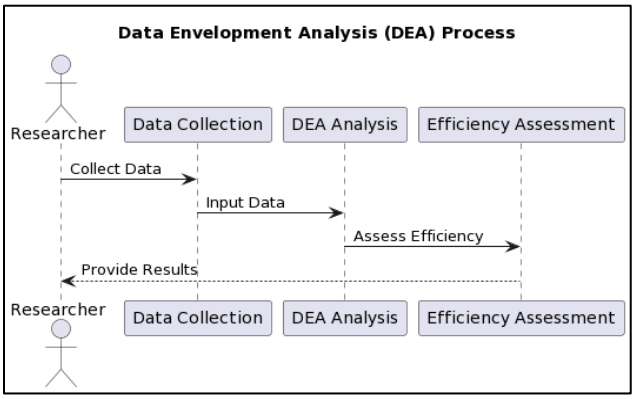


Figure 2. Data Envelopment Analysis (DEA)

A lot of people use Data Envelopment Analysis (DEA), [7] a non-parametric method, to figure out how efficient different decision-making groups are. This could be healthcare facilities or programs. DEA looks at the tools, staff, and money that each unit uses to make outputs (like health services and results) and picks out the units that get the most outputs for the money they spend. By giving efficiency numbers and finding best practices, DEA helps healthcare systems figure out how to best use their resources and improve their performance.

### 2.2 Stochastic Frontier Analysis (SFA)

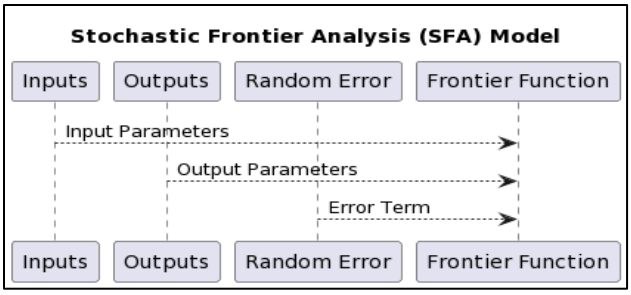


Figure 3: Stochastic Frontier Analysis (SFA)

Stochastic Frontier Analysis (SFA) is [6] a statistical way to figure out the production borders that are the line between what is actually being produced and what is theoretically the highest amount that can be produced, taking into account waste and chance changes. Researchers can use SFA to predict

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technical efficiency and find out what makes healthcare production methods less efficient. SFA helps us understand how to best use resources and improve performance by telling the difference between technical waste and chance mistake.

### 2.3 Cost-effectiveness Analysis (CEA)

The cost-effectiveness analysis (CEA) compares the different treatments' health results and prices to find out which one is the most valuable in terms of achieving health goals. The difference in prices between treatments is divided by the difference in health outcomes by CEA to get the incremental cost-effectiveness ratio (ICER). Interventions with lower ICERs are thought to be more [8] cost-effective, which affects how resources are allocated and how public health policies are made.

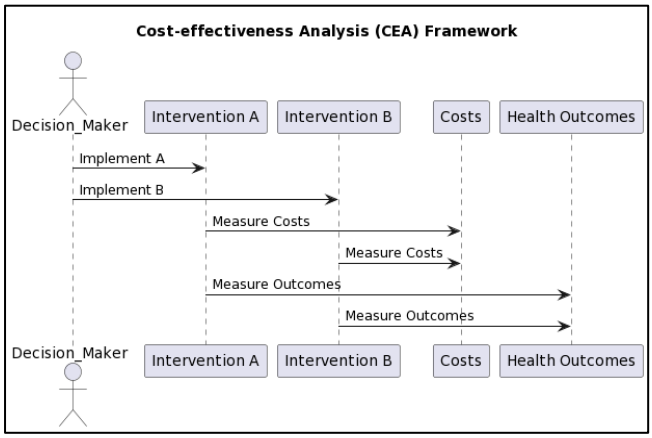


Figure 4: Cost-effectiveness Analysis (CEA)

### 2.4 Quality-adjusted Life Years (QALYs)

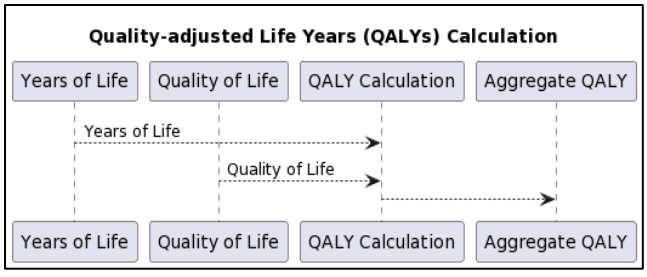


Figure 5. Quality-adjusted Life Years (QALYs)

Quality-adjusted Life Years (QALYs) are a complete way to measure health results because they take into account both the length and quality of life gained from medical treatments. QALYs measure how interventions affect a patient's health-related quality of life. This lets experts compare how well different interventions work for different health problems. QALYs make it easier to decide how to spend public health resources and set priorities by giving a standard way to measure the health effects of actions.

### 2.5 Other Quantitative and Qualitative Approaches

There are many [9] more quantitative and qualitative methods used to measure how efficient and effective public health management is besides the ones listed above. Some of these are economic modeling methods, like regression analysis and propensity score matching, which help researchers figure out how actions affect health outcomes while taking into account things that could make the results less clear. Qualitative tools, like case studies, focus groups, and program reviews, give us a lot of information about the background of public health policies and what makes them work or not work.In general, it's important to use both numeric and qualitative methods when measuring how efficient and effective public health management is. Each method has its own benefits and insights that help people involved make smart choices and use resources in the best way possible to improve the health of the whole community.

## 3. CHALLENGES AND LIMITATIONS

Methods for measuring how efficient and effective public health management is can teach us a lot, but they also have some problems and limits. This part talks about some of the

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biggest problems that come up during the measurement process.

### 3.1 Data Availability and Quality:

The lack of and poor quality data is one of the main problems with figuring out how efficient and effective public health management is. It can be hard to get accurate information on inputs, outputs, and results in many places where health information systems are broken up, missing, or old. Also, data on health results can be subjective or hard to collect, especially when it comes to long-term or complicated illnesses. Fixing data holes and making data better are important for making accurate measurements and smart decisions in public health.

### 3.2 Complexity of Healthcare Systems

Public health management works in complicated healthcare systems with many different parties, ways of providing services, and outside factors. Because of this, it can be hard to figure out how efficient and effective an action is because it may affect more than one factor or result. Also, the links between inputs and outputs in healthcare systems aren't always straight, which makes it hard to correctly model and study their performance. It is important to understand and account for this diversity in order to understand test data and come up with effective solutions [10].

### 3.3 Interdisciplinary Nature of Public Health

The people from many different fields work together on public health. Some of these fields are medicine, statistics, economics, sociology, and public policy. Because it involves many different fields, it can be hard to figure out how efficient and effective something is, since different fields may use different measurements and methods to measure health results. For a full measurement and understanding of efficiency and success in public health management, it is important to include different points of view and methods.

Table 1: Effectiveness and Efficiency work in public healthcare

| Methods | Finding | Efficiency | Effectiveness | Application | Scope |
|---|---|---|---|---|---|
| Data Envelopment Analysis (DEA) [11] | DEA is a non-parametric method used to measure the relative efficiency of decision-making units (DMUs) based on their inputs and outputs. | DEA can identify inefficient DMUs and provide insights into best practices for improving efficiency. | DEA does not consider the quality of outputs, which may limit its ability to assess overall performance. | DEA can be applied to measure the efficiency of public health programs or interventions by comparing inputs (resources) to outputs (health outcomes). | DEA can be used to assess the efficiency of public health programs, facilities, or interventions, helping policymakers allocate resources more effectively. |

| | | | | | |
|---|---|---|---|---|---|
| Cost-Effectiveness Analysis (CEA) [12] | CEA compares the costs and outcomes of different interventions to determine the most cost-effective approach. | CEA can help policymakers prioritize interventions based on their cost-effectiveness, ensuring that resources are used efficiently. | CEA may not account for all relevant costs and outcomes, leading to potential biases in decision-making. | CEA can be applied to assess the cost-effectiveness of public health interventions, such as vaccination programs or health promotion campaigns. | CEA provides insights into the value for money of public health interventions, helping policymakers make informed decisions about resource allocation. |
| Quality-adjusted Life Years (QALYs) [14] | QALYs measure the quality and quantity of life gained from a healthcare intervention, providing a standardized measure of effectiveness. | QALYs allow policymakers to compare the effectiveness of different interventions across different health conditions. | QALYs may not capture all aspects of health-related quality of life, leading to potential limitations in measuring effectiveness. | QALYs can be used to assess the effectiveness of public health interventions by estimating the health gains achieved relative to the costs. | QALYs provide a comprehensive measure of effectiveness, incorporating both quantity and quality of life gained from interventions. |
| Return on Investment (ROI) [13] | ROI measures the financial return of an investment relative to its cost, providing insights into the efficiency of resource allocation. | ROI can help policymakers prioritize investments based on their expected returns, maximizing the impact of limited resources. | ROI may not capture non-financial benefits or costs, which could affect its utility in assessing overall efficiency. | ROI can be applied to assess the efficiency of public health programs or interventions by comparing the financial returns (e.g., healthcare savings) to the costs. | ROI provides a clear metric for assessing the efficiency of public health investments, helping policymakers make informed decisions about resource allocation. |
| Statistical Process Control (SPC) [15] | SPC is a method used to monitor and control processes over time, allowing for the identification of trends and deviations from expected performance. | SPC can help identify inefficiencies or areas for improvement in public health management processes. | SPC may require a substantial amount of data to be effective, which could be a limitation in some public health contexts. | SPC can be applied to assess the efficiency of public health management processes, such as patient flow or resource utilization. | SPC provides a systematic approach to monitoring and improving the efficiency of public health management processes, ensuring that resources are used effectively. |
| Lean Six Sigma [16] | Lean Six Sigma is a methodology that combines Lean principles (focused on reducing waste) with Six Sigma (focused on improving quality) | Lean Six Sigma can help streamline processes and eliminate waste in public health management, leading to increased efficiency. | Lean Six Sigma may require significant time and resources to implement, which could be a barrier to its | Lean Six Sigma can be applied to improve the efficiency of public health management processes, such as inventory | Lean Six Sigma provides a structured approach to process improvement, ensuring that public health management processes are efficient and effective. |

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| | | | | | |
|---|---|---|---|---|---|
| | to achieve process improvements. | | adoption in some settings. | management or patient scheduling. | |
| Balanced Scorecard [17] | The Balanced Scorecard is a strategic planning and management tool that aligns organizational activities with the vision and strategy of an organization. | The Balanced Scorecard can help public health organizations track performance against strategic goals, ensuring that resources are used effectively. | The Balanced Scorecard may not capture all aspects of organizational performance, which could limit its utility in assessing efficiency. | The Balanced Scorecard can be applied to assess the efficiency of public health organizations by measuring performance across key areas, such as financial, customer, internal processes, and learning and growth. | The Balanced Scorecard provides a comprehensive framework for assessing and improving the efficiency of public health organizations, ensuring that they are aligned with strategic goals and objectives. |

### 3.4 Contextual Factors and Externalities

Interventions in public health happen in complicated social, economic, and political settings that might affect how well they work. Disparities in socioeconomic status, cultural views, government systems, and external factors can all affect how well programs work and how their results are measured. Also, public [18] health measures might have benefits that go beyond the community they are meant to help, like herd immunity or side effects. It is important to take these outside factors and contexts into account when measuring and interpreting how efficient and effective public health management is.

### 3.5 Ethical and Equity Considerations

When managing public health, measuring how efficient and successful things are brings up important social and fair issues. For instance, putting solutions at the top of the list based only on how much they cost could mean ignoring the needs [19] of vulnerable or neglected groups. In the same way, using total numbers to show health results might hide differences between groups, making it harder for some people to get the care they need. To make sure that public health measures are both successful and fair, it is important to find a balance between efficiency and fairness.

## 4. APPLICATIONS AND CASE STUDIES

This part talks about real-life examples and case studies of how methods for measuring efficiency and success in public health management have been used. By looking at real-life cases, we can learn how these methods are used to help people make decisions and improve their health.

### 4.1 Assessing Efficiency and Effectiveness of Healthcare Facilities

One use for measuring speed and usefulness is to judge how well healthcare facilities are doing. For instance, DEA has been used to judge how efficient hospitals are by comparing their inputs (like worker numbers and medical tools) to outputs (like patient results and quality of care). By finding facilities that aren't working well and the best ways to do things, healthcare managers can better use their resources and make focused changes to boost performance.

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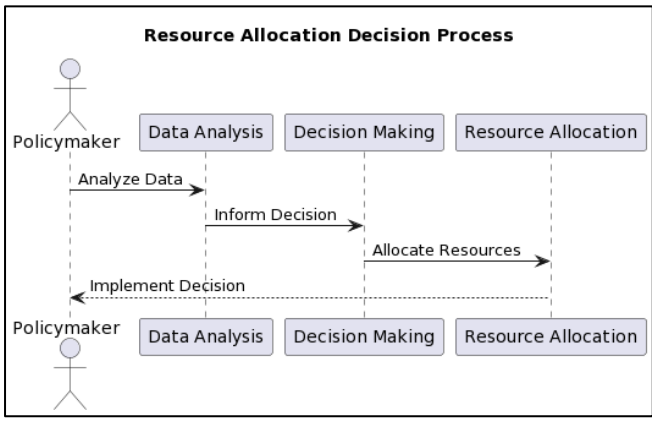


Figure 6. Resource Allocation and Qualitative Process

Case Study: Evaluating the Efficiency of a Hospital

Researchers in a regional health care [20] system used DEA to figure out how well hospitals provided maternity care services in a study. The study found ways to improve quality and make the best use of resources by comparing inputs (like the number of obstetricians and hospital beds) to outputs (like the health results for mothers and babies). The research led to strategic decisions that moved staff and resources to hospitals that were doing a good job. These decisions led to the creation of standard practices to improve the quality of patient care.

### 4.2 Evaluating Interventions in Public Health

Measuring efficiency and success is also important for figuring out how well public health measures work. For example, cost-effectiveness research helps lawmakers figure out how well different health measures work at meeting their goals. By looking at both costs and benefits, people making decisions can figure out which actions will have the biggest effect and best use of resources.

Case Study: Evaluation of a Vaccination Program

Researchers used CEA to compare [21] the prices and health benefits of immunizing children against different diseases as part of a study that looked at how cost-effective a youth vaccine program was. The study gave lawmakers proof to back up their choices to spend in vaccine programs by calculating the costs per life saved or disability-adjusted life year (DALY) avoided. The study showed that immunization against some diseases, like measles and polio, was very cost-effective, meaning that it gave people a lot of health benefits for a small amount of money.

### 4.3 Decisions About Allocating Resources

Part of figuring out how to use public health resources is also figuring out how to measure success and efficiency. They can put money and resources where they will have the most impact on the health of everyone in the community by finding out which measures give the best return on investment.

Case Study: Allocating Funds for an HIV/AIDS Prevention Program

When resources were limited, officials had to decide how to give limited funds to different HIV/AIDS protection efforts. Researchers used both cost-effectiveness analysis and budget impact analysis to look at the costs and health effects of various HIV prevention methods, such as giving out condoms, tests for HIV, and antiretroviral treatment. The research helped lawmakers figure out which programs were the best value for money and then divide resources in a way that made the most of limited funds while still preventing HIV/AIDS.

### 4.4 Policy Implications

Measuring efficiency and success has big policy effects on how public health is managed. Measuring methods help policymakers make

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choices and help people come up with good ways to improve everyone's health by showing how treatments work and how much money is worth spending on health.

The case study looks at a policy meant to stop people from smoking.

There was a study that looked at how well policies like smoking bans, tobacco taxes, and public education campaigns against tobacco affect people. The study used both qualitative and quantitative methods to look at these policies. There were changes in the number of people who smoke, the sicknesses and deaths they cause, and the prices of health care. This showed politicians why they should support full smoke control laws. The results showed how important it is to take steps based on facts to improve public health and lower the number of diseases caused by smoking [22].

## 5. FUTURE DIRECTIONS

As the field of public health management changes, it is important to think about where it might go and what chances there are to improve how speed and success are measured. This part looks at possible areas for growth and ends with a summary of the main points of this study paper.

### 5.1 Emerging Methodologies and Technologies

Improvements in data analytics, machine learning, and artificial intelligence can help public health managers better measure how efficient and effective they are at their jobs. Big data analytics let you combine different sets of data from different sources, which lets you do more in-depth studies and gain more insights. It is possible for machine learning systems to find complicated trends and connections in healthcare data. This can help predict health results and make treatments more effective. Also, digital health tools like smart tech and mobile health apps give us new ways to track health habits and results in real time, which lets us handle public health in a more proactive and personalized way.

### 5.2 Addressing Challenges and Limitations

Getting rid of problems with data access, quality, and complexity is important for making it easier to measure how efficient and effective public health management is. Improving health information systems, making data collection and reporting more consistent, and making it easier for data to be shared and used across systems are all important for making sure that data for analysis is available and accurate. Collaborations and programs that build people's skills across different fields can also help people learn how to use new tools and methods to measure how efficient and effective public health programs are.

### 5.3 Importance of Continuous Evaluation and Improvement

Evaluation and growth all the time are important parts of managing public health. Stakeholders can find places to improve, track progress toward goals, and change tactics as needed by regularly checking and evaluating performance measures. Stakeholders can make sure that resources are used well and interventions are designed to meet the needs of target groups by adding quality improvement processes and feedback loops to public health programs and interventions. Also, encouraging a mindset of learning and new ideas in public health groups can lead to constant performance growth and success.

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## 6. RECOMMENDATIONS FOR IMPLEMENTATION AND POLICY

Metrics for measuring how efficient and effective public health management are can teach us a lot, but they need to be turned into policies and practices that can be used in order to reach their full potential. This part gives suggestions on how to use measurement methods and make policy decisions based on the results.

### 6.1 Capacity Building and Training

To get more people in public health management to use measurement methods, it is important to put money into programs that build people's skills and knowledge. Getting healthcare workers, lawmakers, and academics better at data analysis, econometrics, and health economics gives them the tools and information they need to do good reviews and make smart choices. Interdisciplinary collaboration and communication skills should also be emphasized in training programs so that people from different fields can work together and share their knowledge more effectively.

### 6.2 Integration into Decision-Making Processes

At all stages of public health management, measuring methods must be used in decision-making in order for policy and practice to be based on data. Decision-makers should regularly use measures for efficiency and effectiveness to check how well healthcare facilities, programs, and treatments are doing and then transfer resources accordingly. Including measurement results in strategy planning, funding, and policy development also makes sure that money goes to projects that have the best chance of improving the health of the whole community.

### 6.3 Stakeholder Engagement and Transparency

Including people who have a stake in the measurement process increases buy-in and makes results more credible and useful. Stakeholders, such as patients, healthcare workers, lawmakers, and community leaders, should help set measurement goals, choose the right methods, and figure out what the results mean. Also, being open about how data is collected, analyzed, and reported increases trust and responsibility by letting people know how choices are made and how resources are used to support public health goals.

### 6.4 Frameworks for Monitoring and Evaluating

Setting up strong systems for watching and evaluating is necessary to keep track of progress toward public health goals and find places where things can be made better. To get a full picture of success, these models should include a mix of process, result, and effect measures. Stakeholders can find patterns, judge how well actions are working, and make course changes as needed by regularly reviewing measurement data. Adding feedback systems also lets everyone involved learn from wins and mistakes and change their methods to fit.

### 6.5 Policy Alignment and Advocacy

Aligning survey methods with bigger policy goals and pushing for their inclusion in policy plans makes them more effective at improving public health. To help people make decisions based on facts, policymakers should put money into facilities for measurements, data systems, and study. It is also important to support policies that encourage openness, responsibility, and fair distribution of resources. This will make sure that measuring

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results are used to improve health fairness and social justice.

## 7. Ethical Considerations and Equity

In order to find out how efficient and effective public health management is, it is important to think about ethics issues and make sure that both the process of measurement and the results are fair. This part talks about the moral aspects of measurement methods and gives suggestions for making public health management more fair.

### 7.1 Ethical Considerations in Measurement Methodologies

When measuring how efficient and effective public health management is, there are a number of social issues that come up. First, when gathering and reviewing health data, it is important to make sure that people's rights and security are protected. Protecting people's privacy rights helps keep people's trust in the healthcare system and supports the moral ideals of liberty and respect. Second, honesty and responsibility are important moral ideals in measuring methods. Transparency means telling stakeholders about the ideas, methods, and limits of measurement processes so that they can evaluate the truth and trustworthiness of results. Accountability means that people who make decisions have to answer to the people they serve and take responsibility for their actions. This encourages fairness and trust in public health management. Third, it is the right thing to do to put health measures for weak and underserved groups at the top of the list. To make sure that everyone has equal access to healthcare services and chances to achieve their best health results, equity should be taken into account when choosing measurement markers and allocating resources.

### 7.2 Promoting Equity in Public Health Management

To make public health management fairer, we need to work to close the gaps in health results, access to healthcare services, and the factors that affect people's health. Methods of measurement can be very helpful in finding unfair situations and figuring out how to fix them. To begin, methods for measuring should separate data into groups based on important racial and ethnicity, gender, income, and region factors. By looking at differences between groups of people, stakeholders can make sure that solutions are tailored to the needs and problems of disadvantaged areas. Next, when planning and carrying out public health measures, fairness should be taken into account. This includes doing health equity impact studies to see how policies and programs might affect various groups of people and changing tactics to reduce unwanted effects and increase benefits for disadvantaged groups. Third, encouraging community involvement and hands-on methods in public health management gives disadvantaged groups the power to speak up for their health needs and take part in making decisions. Stakeholders can make policies and programs that are more flexible and include everyone by giving the opinions of those most touched by health injustices more weight.

Ethical concerns and supporting fairness are important parts of figuring out how efficient and effective public health management is. A more fair and just healthcare system that makes sure everyone and every community has the best health outcomes can be built by ensuring privacy, openness, and accountability in measurement methods and putting health equity-promoting interventions at the top of the list of priorities.

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## 8. CONCLUSION

It is important to measure efficiency and success in public health management in order to make the best use of resources, improve health results, and move health fairness forward. This study paper looked at different ways to measure these important metrics and how they can be used. It also talked about how important they are for helping policymakers make decisions and leading actions. Some useful methods for measuring efficiency and effectiveness are Data Envelopment Analysis (DEA), Stochastic Frontier Analysis (SFA), Cost-effectiveness Analysis (CEA), and Quality-adjusted Life Years (QALYs). These can be used to judge how well healthcare facilities are doing, how well public health interventions are working, and how resources should be allocated. Stakeholders can learn about how well different healthcare systems are doing, find places where they can be improved, and rank the solutions that will give them the most for their money by using both quantitative and qualitative methods. But it's not always easy or clear-cut to figure out how to measure speed and success in public health management. Data access, quality, and complexity are big problems when it comes to accurate measurement. Ethical and fairness issues need to be carefully thought through in measurement methods and policy choices as well. There are chances to improve testing methods in the future through new tools, programs that build people's skills, and working together across disciplines. Stakeholders can use measurement to improve public health by solving quantitative problems, encouraging openness and responsibility, and putting health equity measures at the top of their list of priorities. Finding ways to make public health management more efficient and effective is a complex task that needs ongoing dedication, teamwork, and new ideas. Advocate for policy consistency, include measurement results in decision-making, and promote equality in public health management. These are some of the things that stakeholders can do to improve health outcomes and make society healthy and more fair for everyone.

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