International Journal of Community Medicine and Public Health
Azhar SM et al. Int J Community Med Public Health. 2024 Nov;11(11):4563-4568
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20243324

Review Article

Herd immunity and sustainable development goals: role of nurses in strengthening primary health care

Azhar S. M.[1], Jaison Joseph[1]*, Durgesh Prasad Sahoo[2], Anoop S.[3], Sam Jose[4], Krishnapriya K.[5],

[1]College of Nursing, AIIMS, Bibinagar, Hyderabad, Telangana, India
[2]Community Medicine & Family Medicine, AIIMS, Bibinagar, Hyderabad, Telangana, India
[3]ESIC College of Nursing, ESIC Medical College Kalaburagi, Karnataka, India
[4]College of Nursing, AIIMS, Bhubaneswar, Odisha, India
[5]SUM Nursing College, Bhubaneswar, Odisha, India

Received: 22 August 2024
Accepted: 06 October 2024

***Correspondence:**
Jaison Joseph,
E-mail: jaisonjsph@yahoo.com

ABSTRACT

Herd immunity has proven as a highly valuable public health concept for dealing with reinfection. It is the immunity developed in a population to an infectious disease through vaccination or previous infection which is contributed by the virulence of the organism, susceptibility of an individual to infection, extent of immunity developed towards the pathogen, occurrence of clinical and subclinical infection in the herd and herd structure. Herd immunity assessment is imperative for continuously monitoring the risk of epidemics. The minimum proportion of the population that needs to be immune to herd effect is called herd immunity threshold which can be achieved through adequate immunization coverage. Immunization contributes to 14 out of its 17 sustainable development goals (SDGs) and is important in reaching SDGs. Nurses play a vital role in strengthening primary health care through vaccination campaigns, addressing vaccine hesitancy, community outreach programs, monitoring and surveillance of diseases, advocacy, and policy development. Nurse practitioners and nurse-led vaccination programs help in reaching underserved communities or groups with vaccine hesitancy and lead to an upsurge in vaccination rates, patient satisfaction, and attainment of community immunity. Thus, vaccination is a powerful, cost-effective public health tool to achieve the eradication of diseases through proper coverage and development of population immunity.

Keywords: Herd immunity, Sustainable development goals, Nurses, Primary health care

INTRODUCTION

The concept of herd immunity was present almost a century ago. It is also called 'population immunity' or ‘community immunity’. It occurs when a large portion of a community (the herd) becomes immune to a disease, making the spread of the disease from person to person less likely. As a result, the whole community becomes protected, even those who are not themselves immune.[1] The concept of herd immunity is based on the assumption that when diseases are passed from individual to individual, it becomes difficult to maintain the chain of infection when a large section of a population is immune. The higher the number of immune individuals, the lower the likelihood that a susceptible individual will come in contact with an infectious agent.[2] Hence this immunity provides indirect protection from an infectious disease that happens when a population is immune either through vaccination or immunity developed through previous infection. It not only protects individuals but also helps in preventing outbreaks and reducing the burden on healthcare systems.[3] Various factors contribute to the

development of herd immunity such as the virulence of the organism, susceptibility of an individual to infection, extent of immunity developed towards the pathogen, occurrence of clinical and subclinical infection, etc.[4]

The concept of herd immunity is based on mathematical models and empirical observations rather than assumptions. Epidemiologists use mathematical models to estimate the threshold for herd immunity and to predict the impact of vaccination campaigns on disease transmission.[5] The level of immunity required to achieve herd immunity varies depending on the infectiousness of the disease, measured by the basic reproduction number (R0), which is the average number of secondary infections produced by a single infected individual in a susceptible population. The R0 determines the herd immunity threshold and immunization coverage required to achieve population immunity.[6]

For example, the basic reproduction number (R0) of novel coronavirus disease was assumed to be around 2-3 and the herd immunity threshold was expected to be 60% to develop herd protection (In the mathematical expression, the herd immunity threshold is defined by 1–1/R0; for example, if R0=2.5, the threshold for herd immunity comes out to be 0.60).[7] To further cite, a study from Spain reported an R0 value of 3.10 and 8.96 for the ancestral SARS-CoV-2 and delta variant of SARS-CoV-2 with a herd immunity threshold of 70% and 90% respectively.[8] Some diseases show a cyclic pattern of occurrence over varying periods due to variations in herd immunity. For example, measles in the pre-vaccination era appeared in cycles with major peaks happening every 2-3 years and rubella every 6-9 years.[9]

The threshold proportion of immune individuals required to achieve herd immunity varies depending on the contagiousness of the disease. The herd immunity threshold varies with the virulence of the disease, the efficacy of the vaccine, and the contact parameter for the population.[5] Achieving herd immunity is crucial in controlling infectious diseases such as measles, polio, and COVID-19. For example, a higher percentage of the population (90-95%) needs to be immune to prevent outbreaks of highly contagious diseases such as measles. Therefore, assessment of herd immunity is imperative for continuously monitoring the risk of epidemics.[10]

HERD IMMUNITY AND SUSTAINABLE DEVELOPMENT GOALS

Achieving herd immunity aligns with several sustainable development goals (SDGs), particularly those related to health and well-being (Goal 3), including targets to end epidemics of communicable diseases, reduce maternal mortality, and combat HIV/AIDS, malaria, and other diseases.[11] Herd immunity contributes to achieving goal 3 by reducing the incidence of infectious diseases and improving overall public health. Additionally, achieving herd immunity can indirectly support other SDGs by reducing healthcare costs, increasing productivity, and promoting economic growth.[12] Herd immunity indirectly supports SDG 1 by reducing the economic burden of preventable diseases on families and healthcare systems. Vaccination campaigns prevent illnesses that can push families into poverty due to medical expenses and lost income.[13] Preventing infectious diseases through population immunity ensures that children can attend school regularly, contributing to SDG 4, which aims to ensure inclusive and equitable quality education for all. Disease outbreaks often disrupt education, particularly in vulnerable communities. Herd immunity can positively impact SDG 5 by reducing the burden of care disproportionately placed on women and girls during disease outbreaks. Vaccination efforts can alleviate caregiving responsibilities, allowing women and girls to pursue education and economic opportunities.[12] Achieving herd immunity promotes sustainable cities and communities by reducing the spread of infectious diseases in densely populated areas. This contributes to SDG 11, which aims to make cities inclusive, safe, resilient, and sustainable.[14]

Vaccination is one of the most effective ways to achieve herd immunity without the associated morbidity and mortality of natural infection. Vaccination programs have been successful in eradicating smallpox and reducing the burden of many infectious diseases worldwide, including smallpox, polio, and measles.[15] Achieving and maintaining herd immunity can be challenging due to factors such as vaccine hesitancy, waning immunity, and the emergence of new variants. Sustained efforts in vaccination coverage and public health measures are necessary to prevent outbreaks and maintain herd immunity levels.[16]

Literature on vaccination and sustainable development goals (SDGs) emphasizes the crucial role of immunization in achieving several SDGs related to health, education, poverty reduction, and economic growth. A comprehensive insight into the positive impact of vaccination on achieving sustainable development goals reveals that it prevents medical expenses associated with treating vaccine-preventable diseases, thus reducing the financial burden on families and contributing to poverty alleviation.[17] Further, vaccination programs promote economic growth by reducing healthcare costs, increasing productivity, and fostering a healthy workforce. Immunization programs help improve school attendance rates by reducing the incidence of vaccine-preventable diseases, leading to better educational outcomes.[18]

To achieve herd immunity, the proportion of the population that needs to be vaccinated will vary with each disease. For example, 95% of the population needs to be vaccinated for achieving population immunity against measles whereas in polio, the threshold is about 80%. This means after vaccination against measles and polio, the remaining 5% and 20% proportion of the population

respectively will not acquire or spread the infection because of the herd effect.[19] Selective vaccination among the children with maximum transmission of the disease prevents the occurrence of illness among risk groups through herd effect. Evidence from Japan suggests that vaccination of school children during the period of 1962 to 1987 resulted in the development of herd immunity and protection which reduced mortality from influenza among older persons.[20] WHO recommends the use of malaria vaccines for the prevention of Plasmodium falciparum malaria in children living in endemic areas.[21] The introduction of this 'transmission-blocking vaccine' does not prevent infection but will develop antibodies that block life cycle changes of the parasite in mosquitoes which may develop a herd effect later.[22]

Achieving herd immunity for certain infectious diseases may be challenging due to various factors such as the nature of the pathogen, vaccine efficacy, vaccination coverage rates, and the emergence of new variants. Despite the availability of a highly effective vaccine, measles outbreaks continue to occur in communities with lower vaccination rates, often due to vaccine hesitancy or lack of access to healthcare.[23] Additionally, the level of vaccination coverage required for herd immunity against COVID-19 is still uncertain due to factors like the effectiveness of vaccines against emerging variants.[24] These examples highlight the challenges in achieving herd immunity for certain infectious diseases, emphasizing the importance of maintaining high vaccination coverage rates, developing effective vaccines, and implementing public health measures to control the spread of infectious diseases.

ROLE OF NURSES IN STRENGTHENING PRIMARY HEALTH CARE

Nurses play a crucial role in strengthening primary healthcare systems, especially in the context of achieving herd immunity against infectious diseases. Their expertise in public health and patient care is instrumental in safeguarding the health of communities. By implementing the following strategies, public health nurses play a critical role in increasing vaccination coverage and protecting the health of communities against infectious diseases.

Vaccination campaigns

Nurses are often at the forefront of vaccination campaigns, administering vaccines and educating the public about their importance. Their expertise in patient care and communication helps build trust in vaccines and encourages higher vaccination rates, contributing to the attainment of herd immunity.[25] They educate people about the importance of vaccination in achieving herd immunity and address concerns and misconceptions related to vaccines. Nurses should ensure that the vaccination sites are arranged such that it should be accessible to the beneficiaries. Reminder/recall systems regarding the date of vaccination need to be conveyed to family members through community health workers. Every measure should be taken to reduce out-of-pocket expenditure for the families related to the immunization program. Further, public health nurse has a responsibility to maintain a friendly atmosphere with family members and motivate them for immunizations during their family health visits.[26]

Addressing vaccine hesitancy

Maintenance of high vaccine coverage in a community is a hectic task as many people are still reluctant to take vaccines because of no faith in vaccinations, religious issues, miscommunication, etc. Sometimes when the disease declines in frequency people may show resistance and question the vaccination program. Nurses are skilled communicators who can address vaccine hesitancy by providing evidence-based information, addressing misconceptions, and addressing concerns in a compassionate and non-judgmental manner. By building rapport with patients and addressing their concerns, nurses can help increase vaccine acceptance and uptake, thereby contributing to herd immunity.[27]

Community outreach programs

Public health nurses are routinely engaged in community outreach programs to educate individuals and communities about the benefits of vaccination and the risks associated with vaccine-preventable diseases. By providing accurate information and addressing concerns, nurses empower individuals to make informed decisions about their health and the health of their communities. Nurses work to dispel myths and misinformation surrounding vaccines and encourage vaccination uptake.[28] Public health nurses have a crucial role in reaching underserved populations and providing access to vaccines and information about preventive measures. This may involve setting up mobile vaccination clinics in rural areas or organizing vaccination drives in urban neighborhoods. Further, nurses provide care and support to individuals who are infected with contagious diseases, helping to prevent further transmission within healthcare settings and the community. Through proper infection control practices and patient education, nurses help contain the spread of infectious diseases.[29]

Monitoring and surveillance

Nurses play a vital role in monitoring vaccine coverage rates and disease outbreaks within their communities. Through their close interaction with people in the community, they can identify children who have missed doses of vaccination and ensure they receive the complete vaccinations as per schedule to contribute to herd immunity. Nurses play a key role in disease surveillance and monitoring, identifying outbreaks, and implementing control measures to prevent further spread. Public health nurses collaborate with healthcare providers, including

physicians, clinics, and hospitals, to ensure that vaccination services are readily available and integrated into routine healthcare delivery. This further helps public health authorities to track immunization coverage rates and identify underserved populations.[30]

Advocacy and policy development

Nurses can advocate for policies that support immunization efforts and promote access to vaccines for all individuals, regardless of their socioeconomic status or geographical location. Through their involvement in professional organizations and public health initiatives, nurses influence policy development and implementation to strengthen immunization programs and achieve herd immunity goals.[31] They contribute their expertise to policy development processes at local, national, and international levels to ensure that vaccination programs are accessible, equitable, and effective. Nursing professionals also contribute to research efforts aimed at improving vaccination strategies and understanding the dynamics of infectious diseases. They may also advocate for policies that support vaccination efforts and public health initiatives aimed at achieving herd immunity.[32]

ROLE OF NURSE TO BOOST HERD IMMUNITY AND SUSTAINABLE DEVELOPMENT GOALS: WHAT DOES THE LITERATURE SAY?

Research studies on herd immunity and the involvement of nurses can provide valuable insights into how healthcare professionals contribute to achieving and maintaining population immunity against infectious diseases.

Nurse-led vaccination programs

The available evidence suggests the importance of nurse-led vaccination programs in improving public health and reaching out to various populations, including underserved communities or groups with vaccine hesitancy.[33] The common outcome measures of these programs were vaccination rates and the impact on community immunity.[34] Some of the studies compared the efficiency of nurse-led vaccination programs to that of traditional physician-led programs. Further, there are data in which nurses were involved in increasing the quality of influenza vaccination programs through various modes including web-based approaches.[35]

The result of a pilot nurse-led program showed an overall increase in immunization uptake and the parents felt the immunization practices were delivered safely and efficiently through proper infection control practices.[36] Apart from these, Emily Penick et al. evaluated the cost-effectiveness of nurse-led human papillomavirus (HPV) vaccination programs and found that nurse-led interventions were cost-effective in occupational settings.[37] Furthermore, evidence suggests that nurse-led vaccination programs are effective in increasing vaccination rates and improving access to vaccines in vulnerable populations such as homeless people, and school children.[38,39]

Nurse practitioners and immunization

Research on the role of nurse practitioners in promoting vaccination uptake explored their ability to provide education, counseling, and vaccination services, particularly in primary care settings. Having insight into nurse practitioners' experiences as vaccinators is valuable for future healthcare workforce planning as this workforce is one of the most rapidly growing professions in primary healthcare.[40]

The available studies suggest that immunization practices, including their education, training, and clinical experiences need to be improved to some extent. Further, improvement in immunization counseling and patient advocacy will help to address some of the barriers that prevent equitable vaccine access.[40,41] Nurse practitioner-led COVID-19 vaccination programs are very effective for increased coverage and to achieve population immunity along with other health care community.

A study in Melbourne observed that after endorsing immunization nurse practitioners, there was a 140% increase in uptake of meningococcal B vaccine, improved delivery of immunizations to special group patients, improved opportunistic immunization of inpatients, and improved access to health advice. Nurse practitioners will provide holistic patient care and also contribute to policy-making, education, research, leadership, and management.[41] Nurse practitioners play an important role in mass vaccination campaigns to combat vaccine hesitancy by using multi-component approaches and astute maintenance of alliance with the families.[42] A study on nurse practitioners reported that lack of motivation and knowledge are the main barriers to reporting adverse effects following immunization (AEFI). This further warrants the need for training in AEFI surveillance.[43]

Training and engagement of nurses in out-reach programs

Research on the impact of training and engagement of nurses in out-reach programs highlights the need for specific training interventions or educational materials for enhancing vaccine delivery and promoting vaccine acceptance in the primary care setting. Empirical studies suggest the crucial role of nurses in addressing vaccination awareness and acceptance through community outreach and engagement activities.[44] Evidence also suggests that engaging nurses in outreach vaccination programs can significantly enhance vaccine uptake and community health outcomes due to their expertise in patient care and education.[34,45,46] Additional training requirements need to be addressed to nurses regarding how to report AEFI following immunizations.

Many people still have no idea what Nurse practitioners do and how they play an integral role in immunization programs. Lack of acceptance by staff and people is another limitation faced by nurse practitioners. The lack of policy development in many countries hinders their independent role in practice.

CONCLUSION

Achieving herd immunity aligns with several Sustainable Development Goals (SDGs), and a steady and complete coverage of vaccination helps to overcome infectious diseases safely and securely by achieving population immunity. Nurses play a vital role in contributing to herd immunity as they are the backbone of immunization programs. Nurse practitioners and nurse-led vaccination programs contribute to the advancement of vaccination coverage, and attainment of herd immunity, and thus play a vital role in reaching SDGs.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Azhar SM, Joseph J, Sahoo DP, Anoop S, Jose S, Krishnapriya K. Herd immunity and sustainable development goals: role of nurses in strengthening primary health care. Int J Community Med Public Health 2024;11:4563-8.