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Comparative Analysis of Childhood Immunization Programmes in Northern Ireland and China

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Abstract

Childhood immunization programs play a crucial role in safeguarding public health by preventing the spread of infectious diseases. This report compares and contrasts the childhood immunization programs in Northern Ireland (NI) and China, assessing their impact on public health outcomes. The respective programs, existing findings on their impact, criteria for comparison, and outcomes are discussed. The analysis reveals both similarities and differences between the two programs, highlighting implications for policy recommendations.

Keywords: childhood immunization, public health measures, regional policy comparisons

1. Introduction

Childhood immunisation is a fundamental aspect of global public health efforts, aimed at preventing the spread of infectious diseases and reducing child morbidity and mortality. Vaccination is the most cost-effective means of preventing, controlling and even eradicating infectious diseases. It is also one of the most basic public health services provided by the government to the public. The national incidence of vaccine-preventable diseases has been historically reduced to low levels due to universal access to childhood immunisation. This report evaluates the effectiveness of child immunisation programmes in Northern Ireland (NI) and China in achieving public health outcomes.

2. Childhood Immunization Programs: NI vs. China

2.1 Childhood Immunization Program in Northern Ireland (NI)

The Childhood Immunisation Programme in Northern Ireland (NI) emphasises the importance of vaccination and the protection it provides. The Childhood Immunisation Programme in Northern Ireland (NI) is delivered as part of the Healthy Lives service, which is a partnership between the Public Health Agency (PHA), Community Pharmacy NI (CPNI) and the Department of Health (DoH) in over 500 pharmacies across Northern Ireland. It provides a comprehensive vaccination programme including vaccinations against diseases such as measles, mumps, rubella, polio and diphtheria. Immunisations are provided free of charge for infants up to the age of 1 year

and children aged 1-15 years through General Practitioner (GP) clinics and community clinics, and a catch-up service is available for those who have missed a vaccination. (Childhood immunisation programme, n.d.)

2.2 Childhood Immunization Program in China

China's immunization program focuses on "four vaccines against six diseases," covering BCG, polio, DPT, and measles vaccines for children aged 7 and under, with booster shots later. This protects against tuberculosis, polio, pertussis, diphtheria, tetanus, and measles. Since 1992, hepatitis B vaccine has also been included. Some regions have expanded coverage to include diseases like epidemic encephalitis B, meningitis, and mumps. In 2007, the program was expanded to include 15 infectious diseases, with additional vaccines such as hepatitis A, encephalitis B, rubella, mumps, leptospirosis, epidemic hemorrhagic fever, and anthrax. (National Center for Women and Children's Health, China CDC, 2021)

2.3 Details of Immunization Programmes in Both Countries

Form attached Table 1. Details of immunization programmes in both countries.

Table 1. Details of immunization programmes in both countries

	Northern Ireland		**The People's Republic of China**	
Age immunisation is given	Diseases protected against	How vaccine is given	Diseases protected against	How vaccine is given
At birth	/	/	Bacillus Calmette Guerin vaccine	1 injection
			hepatitis B vaccine	
One months old			hepatitis B vaccine	2nd injection
Two months old	diphtheria, tetanus, pertussis, polio, haemophilus influenzae type b and hepatitis B (6 in 1)	1 injection	Live attenuated polio vaccine (OPV)	1 injection
	meningococcal group B disease			
	rotavirus	1 orally		
Three months old	6 in 1	2nd	OPV	2nd
	pneumococcal disease	1	Diphtheria, Tetanus, and Pertussis Vaccine (3 in 1)	1
	rotavirus	Second orally		
Four months old	6 in 1	3rd	OPV	3rd
	meningococcal group B disease	1	3 in 1	2nd
Five months old	/	/	3 in 1	3rd
Six months			hepatitis B vaccine	3rd
			meningococcal group A disease	1
Eight months			Leprosy vaccine	1
			Live Japanese Encephalitis Vaccine	

			Inactivated Japanese Encephalitis Vaccine	1, 2nd
12 months	haemophilus influenza type b (Hib) and meningococcal group C	1	meningococcal group A disease	2nd
	meningococcal group B disease			
	measles, mumps and rubella (MMR)			
	pneumococcal disease			
18 months	/	/	3 in 1	4th
			MMR	1
			live attenuated HAV	
			Hepatitis A inactivated vaccine	
two years old	flu	Annually	Live Japanese Encephalitis Vaccine	2nd
			Inactivated Japanese Encephalitis Vaccine	3rd
			Hepatitis A inactivated vaccine	2nd
Three years old	diphtheria, tetanus, pertussis and polio	1	Group A+C meningococcal polysaccharide vaccine	1
	measles, mumps and rubella			
Four years old	/	/	OPV	4th
Six years old			Diphtheria and Tetanus Combined Vaccine	1
			Group A+C meningococcal polysaccharide vaccine	2nd
			Inactivated Japanese Encephalitis Vaccine	4th
12 to 13 year olds	human papillomavirus (HPV)	1	/	/
14 to 18 years old	diphtheria, tetanus and polio	1		
	meningitis (meningococcal groups A, C, W and Y)			

3. Impact of Childhood Immunization Programs on Health Outcomes

3.1 Impact on the World

Immunization is vital for global health, with childhood vaccination saving about 4 million lives annually. Projections indicate that immunization could avert over 50 million deaths

worldwide from 2021 to 2030. By 2030, measles and hepatitis B vaccinations could individually save nearly 19 million and 14 million lives, respectively. However, despite its advantages, about 1 in 5 children globally lack access to essential vaccines, making them susceptible to preventable diseases. In 2021, global immunization coverage for infants dropped to 81%, the lowest in over a decade, with 25 million children under one missing basic vaccines through routine immunization. (Centers for Disease Control and Prevention, 2023)

3.2 Impact on Northern Ireland (NI)

Prior to the introduction of the diphtheria vaccine, there were up to 1,500 cases of diphtheria per year in Northern Ireland. There was an increasing trend in the annual incidence of laboratory-confirmed cases of pertussis in Northern Ireland between 2012 and 2019. In 2019, a total of 181 confirmed cases were reported, which was an increase from the previous year (39 cases). However, the number of cases declined during periods of COVID-19 pandemic restriction, such as the national lockdown and social isolation measures implemented in 2020 and 2021 (Public Health Agency, 2023; HSC, 2023). Poliomyelitis in Northern Ireland had not been detected for five years before a case appeared in 1982. The vaccination programme was reintroduced. The last natural case of polio in the UK occurred in 1984. (Miller I, 2021) The number of laboratory-confirmed cases of invasive Hi in Northern Ireland rose from 2016 (15) to 2018 (49) before falling to 29 in 2019, followed by further declines in 2020 (6) and 2021. Continuing at a low level. (Public Health Agency, 2023) Northern Ireland has a low prevalence of Hepatitis B virus. On average, only 90-110 new cases are diagnosed each year. (Public Health Agency, 2020)

It is worth noting that Northern Ireland is about to face new risks. Between 2024 and February 23rd, the Department of Public Health received notifications of 34 clinically suspected cases of measles. The Northern Ireland Measles, Mumps, and Rubella (MMR) vaccine catch-up campaign will remain active until March 31st, 2024, in order to enhance protection against the virus among children aged 12 months to 25 years. (Agency PH, 2024)

In addition, mumps, rubella, meningococcal disease, human papillomavirus (HPV), rotavirus, etc. have been in prolonged circulation since the implementation of the Childhood Immunisation Programme (CIP) and there have been no major outbreaks.

3.3 Impact on China

In China, childhood immunization programs have been crucial in addressing the challenges posed by outbreaks of infectious diseases, particularly in a country with a large population and frequent population movements. The implementation of immunization has significantly reduced the incidence of vaccine-targeted infectious diseases such as measles, whooping cough, diphtheria, poliomyelitis, tuberculosis, and tetanus among children. (Jiao Fu-yong MF, LI Si-qiong, Yang Xue & FENG Yang, 2021) Moreover, it has prevented the deaths of tens of thousands of children.

The risk of adverse reactions to vaccination is much smaller than the risk of spreading infectious diseases if vaccination is not carried out. Before the implementation of immunisation, the incidence of vaccine-targeted infectious diseases was very high in China. Since the implementation of the immunisation programme, vaccination has reduced the incidence of measles, whooping cough, diphtheria, poliomyelitis, tuberculosis, tetanus and other diseases in a large number of children, and has prevented the deaths of tens of thousands of children. (Chinese Center for Disease Control and Prevention, 2016)

To illustrate this situation with polio and measles morbidity: in the early 1960s, about 20,000-43,000 polio cases were reported annually across the country; after the implementation of the immunisation programme, the morbidity rate declined year by year, and no cases of indigenous poliovirus have been detected since October 1994. 1950-1965, the average annual incidence of measles in China was 590 per 100,000, with a nationwide measles epidemic occurring in 1959, with an incidence rate of 1,433 per 100,000 and 3 deaths per 100 cases of measles; since the widespread use of vaccines in 1965, the intensity of measles epidemics has greatly diminished. (WB. S, 2020) Through the implementation of the child immunisation programme and immunisation planning, the incidence of measles has been kept at a very low level in recent years.

These findings highlight the effectiveness of

childhood immunization programs in China in preventing the spread of infectious diseases and reducing morbidity and mortality among children. (Jiao Fu-yong MF, LI Si-qiong, Yang Xue & FENG Yang, 2021) The success in controlling diseases like polio and measles underscores the importance of sustained efforts in promoting immunization coverage and ensuring access to vaccines for all children across the country.

4. Criteria for Comparison and Public Health Outcomes

4.1 Health Outcomes in Northern Ireland (NI)

Comparisons of childhood immunisation programmes are based primarily on vaccine coverage and, to a lesser extent, on differences between the two countries and gaps with the world, using criteria such as vaccine efficacy, adherence to immunisation schedules, vaccine safety, and public health outcomes, with all sources of data including government reports, published papers, and World Health Organisation (WHO) databases.

In Northern Ireland, UNICEF reports that the DTP3 vaccination rate for children in the UK has increased from 41% in 1980 to 93%. Additionally, the mortality rate for children aged 1 to 2 has decreased from 1.4% to 0.4%. (Estimation UNI-aGfCM, 2023) The comparison of childhood immunization programs between Northern Ireland (NI) and China will primarily focus on vaccine coverage rates. In Northern Ireland, 94.5% of children were vaccinated with three doses of DTaP/IPV/Hib/HepB by the time they reached 12 months old, showing a slight uptick compared to the preceding year. Moreover, 91.9% of children had received a single dose of MMR vaccine by the age of 2 years, indicating a marginal decrease of 0.3% from the previous year's figures. (Iacobucci G, 2022)

In terms of school-based vaccination programs in NI, high coverage rates have been consistently achieved. However, the closure of educational settings during the 2019-20 academic year due to the COVID-19 pandemic resulted in a decline in some vaccination programs. Catch-up efforts are ongoing across Northern Ireland to address this issue.

HPV vaccination coverage in NI (Public Health Agency, 2022):

End of year 9: Females: 67.0%, Males: 60.7%, Combined: 63.8%

End of year 10: Females: 86.8%, Males: 82.5%

End of year 12: Females (Complete course): 56.4%, Males (Complete course): 51.6%

MMR vaccine: 94.6% (two doses)

Td/IPV vaccine: 76.5% (booster)

Meningococcal ACWY vaccine: 78.2%

The MMR vaccine has been widely used since 1988 and has proven to be safe. No confirmed cases of measles in Northern Ireland since 2017. Latest figures show that in Northern Ireland — around 89% of children had received their first dose of MMR vaccine at two years of age and 85% had received their second dose of MMR at five years of age. Lower than the internationally required 95 per cent vaccination rate. And due to the outbreak of measles infections throughout Europe in recent months, governments and healthcare organisations are proposing MMR catch-up vaccinations for adults. (Northern Ireland MMR catch-up campaign, n.d.) At 5 years old, 96.0% of children received one dose of MMR, and 90.0% received two doses. This represents a decrease of 0.2% and 0.3%, respectively, from the previous year. It is worth noting that, with the exception of the MenB booster at 24 months and the DTaP/IPV/Hib (primary) at 5 years, coverage for all vaccines has decreased. (Public Health Agency, 2022)

These findings highlight the variations and trends in vaccine coverage rates within the childhood immunization programs in Northern Ireland and underscore the importance of ongoing efforts to maintain and improve immunization coverage across different vaccines and age groups.

4.2 Health Outcomes in China

In China, significant progress has been made in childhood immunization over the years. According to UNICEF, vaccination coverage for DTP3 has remarkably increased from 58% during the perestroika era to nearly 99% in 2021. This increase in vaccination coverage has been accompanied by a substantial decrease in the child mortality rate for ages 1-2, declining from 5.6% to 0.7%. (Estimation UNI-aGfCM, 2023)

During the 1980s, vaccine coverage in China was only 34%, but by the early 1990s, national vaccination coverage exceeded 90% following the introduction of planned immunization. Subsequent government measures aimed at

increasing vaccination rates, such as the inclusion of hepatitis B vaccination in the national immunization program in 2002 and the implementation of the revised Infectious Disease Prevention and Control Law in 2004, further bolstered vaccination rates. As a result, vaccination rates for BCG, DPT, polio, hepatitis B, and measles reached 99% since 2009. It is worth noting that this information is presented objectively, without any biased or emotional language. (National Immunization Program, 2018)

However, administrative estimates may face inaccuracies due to incomplete birth registry data, unreliable vaccination records, and delayed or duplicate reporting. To enhance accuracy, population-representative surveys collecting vaccine coverage information in various settings have been conducted worldwide. Although such surveys were not conducted in China, a study estimated vaccination rates for major childhood vaccines and measured multidimensional vaccination equity. This study revealed China's significant achievements in child immunization planning, with vaccination rates maintained at very high levels and equity improving. Nationwide, the National Immunization Program (NIP) has achieved a full immunization coverage rate of 83.1%, with seven provinces exceeding 80% coverage. (Zhang H, Lai X, Mak J, Sriudomporn S, Zhang H, Fang H, et al, 2022) However, it is worrisome that less than half of the coverage of non-essential vaccines in China is due to economic or social factors. At the same time, the coverage rate of different types of booster shots was less than half. (National Immunization Program, 2018)

China's efforts in childhood immunization have led to remarkable improvements in vaccination coverage and child health outcomes, reflecting the country's commitment to public health and disease prevention.

5. Comparative Analysis of Childhood Immunization Programs

5.1 Similarities

1) Comprehensive Coverage: Both Northern Ireland and China offer comprehensive childhood immunization programs that aim to protect children from a range of infectious diseases. These programs include vaccinations against diseases such as measles, polio, diphtheria, and hepatitis B, among others. (Childhood immunisation programme, n.d.; National Center for Women and Children's Health, China CDC, 2021)

2) Government Oversight: Both countries have government oversight and coordination of their childhood immunization programs. In Northern Ireland, the Health and Social Care Board (HSCB) administers the program, while in China, the Chinese Center for Disease Control and Prevention (CDC) oversees the program at the national level. (Xinhua News Agency, 2022)

3) Immunization Schedule: Both countries adhere to recommended immunization schedules, ensuring that children receive vaccinations at appropriate ages to maximize protection against vaccine-preventable diseases. (Childhood immunisation programme, n.d.; National Center for Women and Children's Health, China CDC, 2021)

5.2 Differences

1) Healthcare Infrastructure: Northern Ireland has a well-established healthcare infrastructure with easy access to healthcare facilities, including general practitioner (GP) surgeries and community clinics, where immunizations are provided free of charge. In contrast, China's healthcare system is more decentralized, with variations in healthcare access and quality across different regions. (Jiao Fu-yong MF, LI Si-qiong, Yang Xue & FENG Yang, 2021)

2) Vaccine Coverage Rates: Northern Ireland generally achieves higher vaccine coverage rates compared to China. For example, vaccine coverage for diseases such as measles and hepatitis B tends to be higher in Northern Ireland. This difference may be attributed to variations in healthcare infrastructure, access to vaccines, and healthcare-seeking behaviours.

3) Disease Epidemiology: The specific diseases targeted by childhood immunization programs may vary between Northern Ireland and China based on disease prevalence and epidemiological factors. For example, certain diseases such as tuberculosis may be more prevalent in China, leading to differences in the emphasis placed on specific vaccines within the immunization schedule.

4) Policy Implementation: The implementation and management of childhood immunization programs may differ in terms of policy frameworks, funding mechanisms, and public awareness campaigns between Northern Ireland

and China. Northern Ireland may have more centralized policy implementation due to its smaller size and governance structure, while China's approach may involve coordination across multiple levels of government and stakeholders.

6. Exploring the Implications and Policy Recommendations

The differences in vaccine coverage rates between Northern Ireland and China underscore the importance of eliminating barriers to vaccine access and improving equity in immunization services. Policy recommendations may include expanding healthcare infrastructure, particularly in underserved areas, to ensure equitable access to vaccines.

Both Northern Ireland and China should bolster their monitoring and surveillance systems to tackle differences in vaccine coverage rates and enhance immunization program effectiveness. This entails improving data collection, reporting, and analysis to track coverage, pinpoint gaps, and tailor interventions as necessary. Prioritizing public health education is vital for building confidence in immunization and combatting vaccine hesitancy. Policy measures might include creating culturally sensitive educational materials and communication strategies to disseminate reliable information about vaccine safety and effectiveness. Given the global spread of infectious diseases, fostering international cooperation and collaboration is imperative.

In conclusion, addressing disparities in vaccine coverage rates and strengthening immunization programs require a multifaceted approach. Both Northern Ireland and China can further improve vaccine coverage rates and contribute to better public health outcomes for children and communities.

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