

Multistakeholder partnerships with the Democratic Peoples' Republic of Korea to improve childhood immunisation: A perspective from global health equity and political determinants of health equity

Hani Kim¹, Florian Marks², Uros Novakovic³, Peter J. Hotez⁴ and Robert E. Black⁵

¹ Bill & Melinda Gates Foundation, Seattle, WA, USA

² International Vaccine Institute, Seoul, Republic of Korea

³ University of Waterloo, Waterloo, ON, Canada

⁴ Sabin Vaccine Institute and Texas Children's Hospital Center for Vaccine Development, Houston, TX, USA

⁵ Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

Abstract

OBJECTIVE To examine the current partnerships to improve the childhood immunisation programme in the Democratic Peoples' Republic of Korea (DPRK) in the context of the political determinants of health equity.

METHODS A literature search was conducted to identify public health collaborations with the DPRK government. Based on the amount of publicly accessible data and a shared approach in health system strengthening among the partners in immunisation programmes, the search focused on these partnerships.

RESULTS The efforts by WHO, UNICEF, GAVI and IVI with the DPRK government improved the delivery of childhood vaccines (e.g. pentavalent vaccines, inactivated polio vaccine, two-dose measles vaccine and Japanese encephalitis vaccine) and strengthened the DPRK health system by equipping health centres, and training all levels of public health personnel for VPD surveillance and immunisation service delivery.

CONCLUSION The VPD-focused programmatic activities in the DPRK have improved the delivery of childhood immunisation and have created dialogue and contact with the people of the DPRK. These efforts are likely to ameliorate the political isolation of the people of the DPRK and potentially improve global health equity.

keywords immunisation, health equity, North Korea, vaccine preventable diseases, vaccines, Democratic Peoples' Republic of Korea, GAVI, International Vaccine Institute, UNICEF, child health

Introduction

The partition of the Korean peninsula into the U.S.S.R.-backed DPRK and the U.S.-backed Republic of Korea (ROK) in 1945, the subsequent Korean war (1950–1953) and the resulting Cold War set the stage for the inter-Korean tension in the following decades and consequent militarisation of the two Koreas [1, 2]. Dissolution of the Soviet Union in 1991 and the loss of trading partners in the communist bloc led to an economic crisis in DPRK,

and a severe strain to its health system [3, 4]. The economic difficulties were exacerbated by a series of floods and drought that caused widespread malnutrition in the 1990s [5]. The extreme strains on the health system led the DPRK government to make an unprecedented appeal for support from the United Nations Children's Fund (UNICEF) and WHO in 1996 [6].

Although this appeal led to some increase in official development aid (ODA) to DPRK, donors' concerns with the political situation (e.g. human rights, nuclear armament) in DPRK have discouraged ODA to DPRK. As a result, ODA has been consistently sparse compared to countries with similar human development indices [7]. The DPRK Government's announcement of nuclear

Disclaimer: The views presented in this article are solely those of the authors and do not represent the views of the Bill & Melinda Gates Foundation or of the International Vaccine Institute.

H. Kim *et al.* **Partnerships to improve childhood immunization**

capabilities in 2006 exacerbated diplomatic isolation of the DPRK and resulted in a range of sanctions passed by the U.N. Security Council (UNSC) [8]. Although these sanctions were intended to specifically target trafficking of materials that could be used for developing weapons, in practice they resulted in a drastic reduction in international funding for humanitarian aid to DPRK due to the fear of misuse of the aid for weapon development and difficulty in monitoring. The sanctions thus have further contributed to the humanitarian funding gap in recent years [7].

The state of human rights in the DPRK has been a source of concern for the international community [9]. However, while the UN Commission of Inquiry on Human Rights in DPRK calls for action by the international community to improve the human rights situation in the country, the Commission does not support sanctions imposed by the UN Security Council that target the population or the economy as a whole, as such sanctions may have adverse effects on the population's right to health. Instead, the Commission recommends that States and civil society organisations foster 'opportunities for people-to-people dialogue and contact in such areas as culture, science, sports, good governance and economic development that provide citizens of DPRK with opportunities to exchange information and be exposed to experiences outside their home country' [9].

Global health equity and a call for global governance for health

The Lancet-University of Oslo Commission on Global Governance for Health recently made a call to improve the global governance processes and structures to address the root causes of global health inequity which are largely political in nature, to ensure sustainable health and development for all [10]. The aim of policy for equity and health, as defined in the Commission's report, is to reduce or eliminate health inequalities that result from factors considered to be both avoidable and unfair. The Commission asserts that it is imperative to ensure that all decisions and activities, in *all* sectors, do not have adverse consequences on global public health and health equity. Among the key messages from the Commission are [10] as follows:

- Health inequities within and between countries cannot be addressed within the health sector, by technical measures, or at the national level alone, but require global political solutions.
- Norms, policies and practices that arise from transnational interaction should be understood as

political determinants of health that cause and maintain health inequities.

- Power asymmetry and global social norms limit the range of choice and constrain action on health inequity; these limitations are reinforced by systemic global governance.
- There is a need for independent monitoring of progress made in redressing health inequities and in countering the global political forces that are detrimental to health.

This review interprets the results of the recent multi-stakeholder partnerships to improve childhood immunisation in DPRK as political determinants of health, demonstrating a potential to reduce health inequity at the global level, as advocated by the Lancet-University of Oslo Commission [10].

Methods

An initial literature search was conducted to identify public health collaborations with the DPRK government through Internet databases Scopus and PubMed. Once specific stakeholders were identified from the initial search, archived reports and articles were found at the websites of specific organisations. Keywords for the initial search were DPRK, North Korea, health, health diplomacy, inter-Korean relations, South Korea. The identified partnerships were categorised according to programmatic focus, and those in childhood immunisation were selected for discussion in this study based on 1) the amount of publicly accessible information about their activities, 2) the shared approach in health system strengthening among the key stakeholders and 3) relationships with the governments of both Koreas. More targeted search was then conducted on GAVI, UNICEF, WHO, IVI, DPRK, immunisation, vaccine preventable diseases (VPD).

Results

Key stakeholders and their roles in childhood immunisation in DPRK

The government of DPRK. The DPRK health system is highly centralised (Figure 1), with the Ministry of Public Health (MoPH) overseeing the surveillance of communicable diseases, outbreak response, water quality and provision of health services through a network of 130 hospitals at central and provincial levels [3]. The DPRK healthcare system was once considered to be functioning well by the UN and ranked highly on multiple UN health

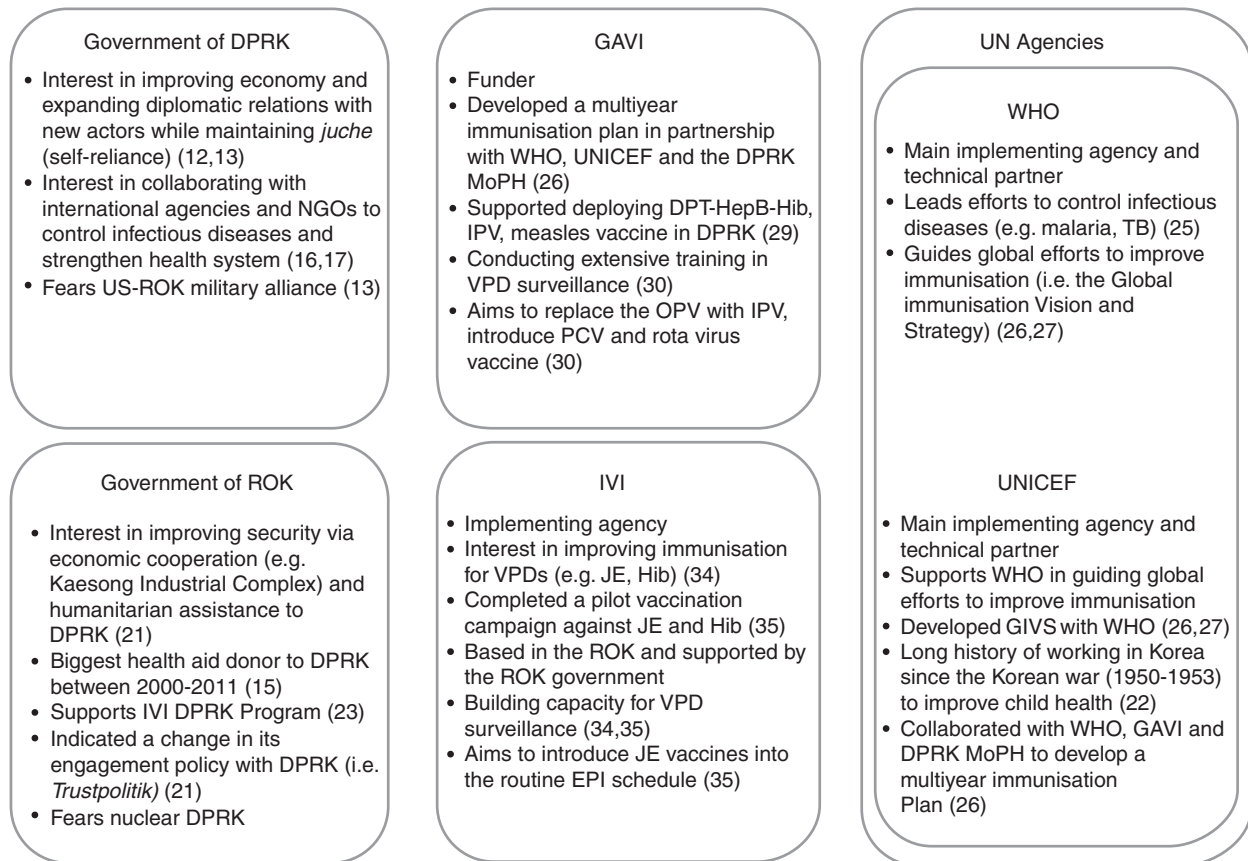
H. Kim *et al.* Partnerships to improve childhood immunization

Figure 1 Key stakeholders. VPD, vaccine preventable diseases; JE, Japanese encephalitis; Hib, Haemophilus influenzae Type b; GIVS, Global Immunisation Vision and Strategy; OPV, oral polio vaccine; IPV, inactivated polio vaccine; PCV, Pneumococcal conjugate vaccine; EPI, expanded programme on immunisation.

assessments [11]. However, the sociopolitical and environmental forces outlined above led to its rapid deterioration [3, 4].

Thus, the DPRK government has made some efforts to engage with the outside world to improve its economy and health system [12] during the last decade (Table 1). After the first major economic reform in 2002, known as 'the Economic Management Improvement', limited market activities were permitted for buying and selling basic commodities and medicines [13].

In public health, WHO, UNICEF, GAVI, IVI, the Global Fund to fight AIDS, Malaria and Tuberculosis (GFATM), among others, have collaborated with the DPRK government despite the concerns with operational difficulties mainly due to the DPRK government restrictions on their movement and access to their target populations [7, 14, 15]. Moreover, a Memorandum of Understanding on Cooperation was signed between the University of Oslo and the the Kim Il Sung University in

2010 to foster academic cooperation in response to the expressed interests by the DPRK MoPH and the Kim Il Sung University in seeking advice in health curriculum development, teaching and research [16, 17].

The operational reality for NGOs in DPRK must be understood in the context of the DPRK's fear of the military alliance between the ROK and the US, and its deeply upheld principle of self-reliance known as *juche* [13]. Consistent with the principle of self-reliance, NGOs and international agencies in DPRK are expected to help rebuild and improve the existing public health infrastructure through capacity strengthening in close collaboration with the DPRK authorities to ensure acceptance and success [14].

The government of ROK. The ROK government aspires to improve the inter-Korean relations in order to reduce military tension with DPRK and to seek ways to promote its economic growth via collaborations with DPRK.

H. Kim *et al.* Partnerships to improve childhood immunization**Table 1** Indicators of health services in DPRK (adapted from reference [40])

Services	
Antenatal care coverage (%)	98
Women that have been immunized with tetanus toxoid during pregnancy (%)	96.5
Deliveries by qualified attendant (%)	97
Children immunized (%)	
BCG	96.5
DPT-3	91.5
Polio-3	99.2
Measles	99
Human resources	
Doctors of modern system (per 10 000 population)	32.0
Highest in the world—Monaco	70.6
Highest in the region—DPRK	32.0
Nurses (per 10 000 population)	38.0
Highest in the world—Norway	319.3
Highest in the region—Maldives	58.4
Other health workers (per 10 000 population)	76.0

Among different engagement policies towards DPRK, the Sunshine policy (1998–2007) saw the highest level of collaboration with, and aid to DPRK [2, 18]. Between 2000 and 2011, the ROK government was the biggest contributor of health aid to DPRK, providing approximately US \$79 million [15]. During the period of the Sunshine policy, an unprecedented degree of collaboration and exchanges of people occurred at the level of government and civil society, with the most notable example being the Kaesong Industrial Complex collaboration [18, 19]. However, critics argue that the Sunshine policy ultimately failed to denuclearise DPRK despite a large amount of aid from ROK to DPRK [20, 21].

Health aid sharply declined after the Sunshine policy, which was replaced with the subsequent engagement policy, the MB Doctrine in 2008 [15]. Named after the president at the time, Myong Bak Lee, the MB Doctrine (2008–2013) prioritised the DPRK nuclear disarmament over normalisation of inter-Korea relations [2]. The period of the MB Doctrine saw a rapid escalation of military tension [18, 21].

The current government's new engagement policy, *Trustpolitik*, is a response to the criticisms of the previous two engagement policies, and an attempt to 'align South Korea's security with its cooperation with the North and inter-Korean dialogue [21]'. The current ROK President Park Geun-Hye recently stated that *Trustpolitik* aims to build trust between the two Koreas through 'incremental gains, such as joint projects for enhanced economic cooperation, humanitarian assistance from the South to the North, and new trade and investment opportunities' [21]. Despite the drop in aid from the

ROK government to DPRK in the recent years, it remains a key donor to other international health agencies including UNICEF, GAVI and IVI [22–24].

WHO and UNICEF. WHO and UNICEF have been the main implementing United Nations agencies and technical partners for health activities in DPRK, including efforts to control TB and malaria [25], and childhood immunisation [15]. For VPD prevention and control, WHO and UNICEF provide guidance on the global immunisation strategy and policy in the framework of the Global Immunisation Vision and Strategy (GIVS) – a ten-year strategic framework to prevent and control VPDs with a greater range of vaccines [26, 27].

WHO and UNICEF serve as technical partners and implementing agencies of the GAVI-funded activities in DPRK; both have been collaborating with the DPRK government since 1985 to strengthen the health system capacity for delivering childhood vaccines [15, 28]. Moreover, UNICEF has a long history of working with the ROK government since the Korean war (1950–1953) [22].

Gavi, the Vaccine Alliance (GAVI). GAVI is a significant external funder of health activities in DPRK, with a total health aid of \$8 million between 2002–2010, and approximately \$39 million approved for activities between 2001 and 2020 [15, 29]. Since 2006, GAVI has been funding activities to strengthen immunisation programmes for preventing childhood illnesses through an health system strengthening approach [3, 30]. GAVI-funded activities have been implemented jointly by UNICEF, WHO and the DPRK MoPH. As part of the GAVI-funded health system strengthening project, the DPRK MoPH, WHO and UNICEF developed the comprehensive multiyear plan for immunisation, which served as a tool to identify barriers to immunisation programmes and health system strengthening (HSS), and to articulate programme goals [26]. The GAVI-funded HSS projects have been multipronged with a focus on new vaccine introduction (e.g. IPV), immunisation service support, injection safety support and HSS [31]. These projects have enabled procurement of vaccines and extensive training of the DPRK public health personnel of all levels in VPD surveillance, including data management, surveillance planning and management, field epidemiology and associated laboratory science involved in VPD surveillance [30]. In addition, GAVI has been providing support to DPRK on deploying pentavalent vaccine (i.e. diphtheria–pertussis–tetanus–hepatitis B–*Haemophilus influenzae type B* (Hib)), inactivated polio vaccine (IPV) and measles vaccine [29]. Funding has been committed to continue their

programmatic activities until 2010 [29, 32, 33]. Future plans include supporting introduction of pneumococcal and rotavirus vaccines pending additional funding [30].

International Vaccine Institute. International Vaccine Institute (IVI) is the only international health research agency that is exclusively based in the ROK. It has a main interest in developing and delivering affordable vaccines, with a focus on diarrhoea and other enteric diseases such as typhoid and cholera as well as other VPDs (i.e. dengue fever, Japanese encephalitis (JE) and Hib) [34]. IVI is an implementing agency, with the Bill and Melinda Gates Foundation (BMGF), the Swedish International Development Agency (SIDA) and the government of the ROK as its core donors [34]. IVI has a unique partnership with the ROK and the DPRK in that it has a programme specifically focused on DPRK, which has been supported by the ROK government since 2006 [23].

In 2008, in close collaboration with WHO, IVI helped the DPRK government conduct a pilot vaccination project to assess the feasibility of mass immunisation campaigns against JE and Hib [35]. The pilot study resulted in 6000 children being vaccinated against JE (3000, in Sariwon) and Hib (3000, in Nampo), with a compliance rate of >98% and >92%, respectively [35]. Furthermore, as part of the project, IVI has equipped and trained personnel on the premises of the Institute of Microbiology, one of 26 research institutes and branch institutes under the Academy of Medical Science, the DPRK medical research arm, to enable diagnosis of JE, infections with selected diarrhoeal, enteric and neurological diseases (i.e. JE, infections with *Vibrio cholerae*, *Campylobacter jejuni*, rotavirus, *Shigella* spp., *Salmonella* spp.) [35]. Importantly, this pilot study was subsequently expanded by the DPRK government to three large-scale vaccination campaigns between 2009 and 2014, which saw over 3 million children immunised in five of nine provinces of DPRK against JE. Currently, efforts are underway to include JE vaccines in the routine Expanded Programme on Immunisation (EPI) schedule [35].

Strengths and achievements

Key achievements of the partnerships demonstrated by WHO, UNICEF, GAVI and IVI include: 1) increased coverage of the diphtheria–pertussis–tetanus (DPT) vaccine, with a rise in third-dose DPT coverage from 37% in 1997 to 96% in 2013 [36], and 2) introduction of new vaccines (i.e. the pentavalent vaccine, IPV and a measles booster at age 15 months to the EPI). One of the factors that enabled achieving the goals and targets of WHO, UNICEF, GAVI and IVI is their commitment to building

the capacity of the DPRK public health system to deliver the immunisation services through training of and collaborations with the DPRK public health personnel at multiple levels [3, 14, 35, 36]. For example, 3925 staff were trained in integrated health management between 2009 and 2013 as part of the GAVI-funded capacity building [30]. Similarly, between 2007 and 2013, the IVI has conducted training programmes in Vietnam and Germany, resulting in a total of 40 doctors, scientists and public health professionals trained in performing epidemiologic investigations and diagnostic procedures [34]. In Pyongyang and six adjacent provinces, approximately 180 doctors and public health professionals were trained in the practical use of epidemiological methodologies. Moreover, IVI closely collaborated with the DPRK public health personnel in preparing operational procedures, evaluating vaccination services (e.g. cold chain), preparing and implementing training materials for local staff, and setting up local laboratory capacity building for diarrhoeal disease diagnosis [35]. Notably, these interactions occurred at multiple levels of the DPRK public health system, including the government officials at MoPH, scientists at the AMS, as well as the health care trainers in rural health centres. Despite the enduring economical and political challenges, the approach to partnerships demonstrated by WHO, UNICEF, GAVI and IVI based on mutual respect and trust-building is likely to create further opportunities for interactions and exchange of information with the people of DPRK in the long term.

Next steps

Carrying their achievements forward, GAVI plans to provide funding support to introduce pneumococcal and rotavirus vaccines [30], and IVI aims to support the DPRK MoPH in introducing JE vaccines into the routine EPI [35]. Importantly, both GAVI and IVI have identified that well-maintained VPD surveillance is a prerequisite for introducing new vaccines to estimate the disease prevalence and to define the target risk populations [30, 35]. WHO and UNICEF recommend that surveillance for VPDs should be performed within the broader context of integrated disease surveillance in line with the Global Immunisation Vision and Strategy framework [26]. WHO has supported the DPRK MoPH to establish an integrated disease surveillance system for 13 diseases; currently, syndromic diarrhoeal disease surveillance is implemented in two provinces (South Pyongan Province and Pyongyang), with the aim to extend it to another six provinces [35]. If successfully scaled, integrated disease surveillance can be transformative in future infectious disease prevention and control of diseases programmes in

DPRK and north-east Asia. Currently, however, insufficient funding and the ongoing political tension on the Korean peninsula are significant roadblocks to executing the proposed plans.

Conclusion

The current state of public health in DPRK is a challenge to global health equity [16]. It is the duty of the government of DPRK to address the *internal* political determinants of health to ensure the welfare of its citizens through appropriate institutional and political reforms as urged by the UN Human Rights Council (UNHRC) [9]. For the international community, the UNHRC recommends that the civil society organisations and the States create opportunities for dialogue and contact with the people of DPRK such that they are exposed to experiences outside their home country. These recommendations support the notion that the underlying causes for the public health problems in DPRK are multifactorial and largely political, dating back to the partition of Korea in 1945, and that these political determinants are unlikely to be resolved by the government of DPRK alone [10, 16].

The ongoing efforts by GAVI, IVI, WHO and UNICEF to engage DPRK on VPD prevention and control are consistent with the recommendations of the UNHRC [9] and represent a response to a challenge to global health equity with a commitment rooted in global solidarity and shared responsibility to ensure health and sustainable development for all [10, 16].

Challenges remain including persistent uncertainties and shortage of funding, scarcity of resources (physical, human) necessary for programmatic activities, and the operational difficulties [7].

To ensure sustainable financing to maintain high immunisation coverage and strengthen the VPD surveillance, expanding the international partnership has been identified as a potential solution [26]. Building upon the existing partnerships can aid in this effort. For example, the unique relationship between IVI and the ROK government can be leveraged to avail an additional source of funding, and support from the ROK government. Given the rising volume of traffic of people between the two Koreas, it would be ideal to have coordinated strategies and programmes to prevent and control infectious diseases on the Korean peninsula. Currently, the example of direct cooperation between the two Korean governments is limited to the Kaesong Industrial Complex project, which operated between 2004 and early this year [37]. While direct cooperation between the two Korean governments

would be ideal to promote public health equity, until there is enough trust built between the two governments, the role of the international agencies remains crucial in engaging the DPRK in public health collaborations [15].

However, engaging the ROK government in an expanded partnership carries the risk of having its political agenda potentially compromise the health programme goals of the international agencies and/or those of the DPRK government. It will be important to clearly define the role of the ROK government to ensure that the independent nature of the international health agencies is not jeopardised and that it is ultimately the right and the responsibility of the national government to decide its priorities to promote health and health equity for its population. The ROK government and the international health agencies can play important roles as partners and supporters for the health programme activities that have been mutually agreed upon with the DPRK MoPH.

The relationships built and trust gained in the current partnerships are likely to enable further opportunities for dialogue and contact with the people of DPRK, and reduce their isolation in the international community. Political and socioeconomic exclusion, perceived and experienced by people as social injustice, is one of the determinants of armed conflict [10, 38, 39]. In the case of DPRK, the perceived fear of war, originating from the Korean war and the Cold War, has been systematically used as a tool to maintain an isolationist approach and an aversion to the outside world to suppress internal resistance against the State's guiding ideology [9]. Greater exposure of the people of DPRK to the experiences with the outside world is likely to reduce this political isolation, and empower the people. It takes empowered people to build the political system they want to live in.

Besides improved delivery of childhood immunisation services, the current partnerships have created dialogue and contact with the people of DPRK, allowing exchange of information. In so doing, they redress to some extent transnational interactions that systematically contribute to the isolation of the people of DPRK in the international community, and cause adverse consequences to their health. The current partnerships demonstrate an approach to improve global health equity by addressing both the immediate public health needs *and* the political origins of health equity observed in DPRK.

References

1. Katsiaficas G. *Asia's Unknown Uprisings: South Korean social movements in the 20th century*. PM Press: Oakland, 2012.

H. Kim *et al.* Partnerships to improve childhood immunization

2. National Committee on North Korea. An overview of inter-Korean relations. [Internet]. NCNK Issue Brief, 2013. (Available from: <http://www.ncnk.org/resources/briefing-papers/all-briefing-papers/an-overview-of-south-korea2019s-dprk-policy>) [26 Apr 2015].
3. Grundy J, Moodie R. Review: An approach to health system strengthening in the Democratic Peoples Republic of Korea (North Korea). *Int J Health Plann Manage* 2009; **24**: 1315–1319.
4. Weitz R. Russia and the Koreans: Past policies and future possibilities. [Internet]. Academic Paper Series on Korea (Korea Economic Institute), 2010. (Available from: <http://www.keia.org/sites/default/files/publications/APS-Weitz.pdf>) [13 Dec 2015].
5. Katone-Ape J, Mokdad A. Malnutrition of children in DPRK. *J Nutr* 1998; **128**: 1315–1319.
6. Owen-Davies J. North Korea's public health tragedy. *Lancet* 2001; **357**: 628–630.
7. United Nations Country Team in DPRK. Overview of needs and assistance: the Democratic People's Republic of Korea [Internet], 2011. (Available from: <http://reliefweb.int/report/democratic-peoples-republic-korea/overview-funding-document-may-2011>) [17 Dec 2015].
8. The UN Security Council. UN Security Council Report [Internet], pp. 1–36. (Available from: <http://www.security-councilreport.org/chronology/dprk-north-korea.php?page=11>) [17 Dec 2015].
9. The UN Human Rights Council. Report of the commission of inquiry on human rights in DPRK [Internet], 2014. pp. 1–36. (Available from: <http://www.ohchr.org/EN/HRBodies/HRC/CoIDPRK/Pages/ReportoftheCommissionofInquiryDPRK.aspx>) [17 Dec 2015].
10. Ottersen OP, Dasgupta J, Blouin C *et al.* The political origins of health inequity: Prospects for change. *Lancet* 2014; **383**: 630–667.
11. Macfarlane S, Racelis F, Muli-Musiime F. Public health in developing countries. *Lancet* 2000; **356**: 841–846.
12. Smith H. *North Korea: Markets and Military Rule*. Cambridge University Press: Cambridge, 2015.
13. Chung YC. North Korean Reform and Opening : Dual Strategy and Silli (Practical) Socialism'. *Pac Aff* 2004; **77**: 283–304.
14. Goe LC, Linton JA. Community-based public health interventions in North Korea: one non-governmental organization's experience with tuberculosis and hepatitis B. *Public Health* 2005 May; **119**: 347–352.
15. Lee H, Ahn DY, Choi S, Kim Y, Choi H, Park SM. The role of major donors in health aid to the Democratic People's Republic of Korea. *J Prev Med Public Health* 2013; **46**: 118–126.
16. Bjertness E, Madar AA. North Korea: a challenge for global solidarity. *Lancet* 2015; **383**: 1381–1382.
17. Stone R. A Wary Pas de Deux. *Science* (80-) [Internet]. 2004; **305**: 1696. Available from: <https://www.sciencemag.org/content/305/5691/1696.2.summary>
18. Moon C-I. *The Sunshine Policy: In defense of engagement as a path to peace in Korea*. Yonsei University Press: Seoul, 2012.
19. Ministry of Unification. Inter-Korean exchanges of people and good. [Internet], (Available from: <http://eng.unikorea.go.kr/content.do?cmsid=1822>) [28 Apr 2015].
20. Popeski R. Sunshine Policy failed to change North Korea: report [Internet]. Reuters, 2010. (Available from: <http://www.reuters.com/article/2010/11/18/us-korea-north-sunshine-idUSTRE6AH12520101118>) [26 Apr 2015].
21. Geun-hye P. A New Kind of Korea building trust between Seoul and Pyongyang. *Foreign Aff* 2011; **9**: 13–18.
22. UNICEF. At a glance: Korea, Republic of [Internet], (Available from: http://www.unicef.org/infobycountry/repkorea_13421.html) [26 Apr 2015].
23. IVI. IVI Annual Report 2012 [Internet], 2012. (Available from: http://www.ivi.int/web/www/04_02) [17 Dec 2015].
24. GAVI. GAVI: Republic of Korea - Proceeds to GAVI from donor contributions & pledges (2011–2015) [Internet], (Available from: <http://www.gavi.org/funding/donor-profiles/republic-of-korea/>) [13 Dec 2015].
25. Perry S, Gresham L, Linton H, Schoolnik G. Engaging North Korea on mutual interests in tuberculosis control. [Internet]. Korea Economic Institute, Academic Paper Series, 2011. pp. 1–13. (Available from: <http://keia.org/sites/default/files/publications/perry.pdf>) [17 Dec 2015].
26. GAVI. Comprehensive Multi Year Plan for Immunization [Internet], 2011. (Available from: www.gavi.org/.../dpr-korea/.../comprehensive-multi-year-plan-for-2011-) [19 Apr 2015].
27. WHO. Global Immunization Vision and Strategy (GIVS) [Internet], (Available from: <http://www.who.int/immunization/givs/en/>) [11 May 2015].
28. UNICEF. Overview: Democratic People's Republic of Korea [Internet], (Available from: <http://www.unicef.org/dprk/overview.html>) [26 Apr 2015].
29. GAVI. GAVI Country Profile - DPRK [Internet], 2015. (Available from: <http://www.gavi.org/country/dpr-korea/>) [15 Apr 2015].
30. GAVI Alliance. GAVI Annual Progress Report on DPRK - 2013 [Internet], 2014. pp. 1–54. (Available from: <http://www.gavi.org/country/dpr-korea/proposals/>).
31. DPR Korea, Proposals, Reports & Plans [Internet]. (Available from: <http://www.gavi.org/country/dpr-korea/documents/#approvedproposal>) [27 Mar 2016].
32. GAVI. Annex A IPV introduction plan- DPR Korea Executive summary [Internet], 2014. (Available from: <http://www.gavi.org/country/dpr-korea/documents/#approvedproposal>) [25 Apr 2015].
33. GAVI. Health System Strengthening (HSS) Cash Support [Internet], 2014. (Available from: <http://www.gavi.org/country/dpr-korea/documents/#approvedproposal>) [25 Apr 2015].
34. IVI. IVI Annual Report 2014 [Internet], 2014. (Available from: http://www.ivi.int/web/www/04_02) [17 Dec 2015].

H. Kim *et al.* **Partnerships to improve childhood immunization**

35. Marks F, Nyambat B, Xu Z-Y *et al.* Vaccine introduction in the Democratic People's Republic of Korea. *Vaccine* 2015; **33**: 2297–2300.
36. Grundy J, Biggs B-A, Hipgrave DB. Public Health and international partnerships in the Democratic People's Republic of Korea. *PLoS Med* 2015; **12**: e1001929.
37. Manyin ME, Nanto DK. The Kaesong North-South Korean industrial complex. [Internet]. Congressional Research Service Report for Congress, 2011. (Available from: <http://fas.org/sgp/crs/row/RL34093.pdf>) [17 Dec 2015].
38. World Bank. World development report 2011: conflict, security, and development. [Internet], 2011. (Available from: http://siteresources.worldbank.org/INTWDRS/Resources/WDR2011_Full_Text.pdf) [17 Dec 2015].
39. Organisation for Economic Co-operation and Development (OECD). Think global, act global: confronting global factors that influence conflict and fragility. [Internet], 2012. (Available from: [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DCD/DAC\(2012\)36&docLanguage=En](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DCD/DAC(2012)36&docLanguage=En)) [17 Dec 2015].
40. WHO. Health System Profile of SEARO Country - DPR Korea [Internet], 2014. pp. 1–10. (Available from: http://www.searo.who.int/entity/health_situation_trends/data/hsp/hsp_2014/en/) [17 Dec 2015].

Corresponding Author Hani Kim, Bill & Melinda Gates Foundation, Seattle, USA. E-mails: Hani.Kim@gatesfoundation.org; hkim180@jhu.edu