

# Medical donations are not always free: an assessment of compliance of medicine and medical device donations with World Health Organization guidelines (2009–2017)

Sally McDonald, Alice Fabbri, Lisa Parker, Jane Williams and Lisa Bero\*

Charles Perkins Centre and School of Pharmacy, Faculty of Medicine and Health, The University of Sydney, D17, The Hub, Sydney, 2006 Australia

\*Corresponding author: Tel: +612 8627 1881; E-mail: lisa.bero@sydney.edu.au

Received 24 September 2018; revised 7 December 2018; editorial decision 17 January 2019; accepted 21 January 2019

Medicine and medical device donations have the potential to improve access to healthcare in some of the poorest parts of the world, but can do more harm than good. World Health Organization guidelines advise donors on how to make effective and useful donations. Our objective was to assess compliance of recent medicine or medical device donations with WHO guidelines from 2009 onwards. We searched media, academic and gray literature, including industry and organizational documents, to identify reports describing specific incidences of the donation of medicines or devices. We collected data on donation characteristics and guideline compliance. We identified 88 reports describing 53 donations. Most did not comply with at least some items in WHO guidelines and no reports provided sufficient information to assess compliance against all items. Donations that fail to comply with guidelines may be excessive, expired and/or burden recipient countries with storage and disposal costs. It was estimated that 40–70% of donated medical devices are not used as they are not functional, appropriate, or staff lack training. More effective donations involved needs assessments, training and the use of existing distribution networks. The donation of medicines and medical devices is frequently inadequately reported and at times inappropriate. Guidelines need to be enforced to ensure effective donations.

**Keywords:** device donation, donation program, drug donation, low and middle income countries, medicine donation, World Health Organization

## Introduction

Global inequities in health systems mean that many low and middle income countries experience shortages of necessary medicines and medical supplies. These disparities are sometimes remedied through donations made by external governments, pharmaceutical companies or non-government organizations (NGOs) to countries<sup>1</sup> or to individual health facilities.<sup>2</sup> Donations of medical aid may occur during emergency situations or as part of long-term programs, such as those targeting neglected tropical diseases (NTDs).<sup>3</sup>

Medicine and medical device donation programs have the potential to improve access to healthcare in some of the poorest parts of the world<sup>2</sup> when done well, such as medicine donations made following the 2001 earthquake in Gujarat, India, or Merck's Ivermectin donation program.<sup>4</sup> However, badly executed donations can cause harm and burden recipient countries.<sup>4</sup> For example, inappropriate and excessive medicine donations made

to Bosnia and Herzegovina from 1992 to 1996 resulted in estimated disposal costs of US\$34 million, and were reported to include surplus medical supplies from World War II.<sup>5</sup> For pharmaceutical companies, medicine donation efforts may be a way to fulfill corporate social responsibility targets, 'dump' medicines they would otherwise have to pay to dispose of<sup>1</sup> and receive tax breaks.<sup>1,5,6</sup> In addition, there has been criticism that donation programs create new markets for products without consideration of how medicines will be purchased once the program ends.<sup>3,7</sup>

The WHO guidelines for medicine donations were created in 1996, then revised in 1999 and 2010.<sup>2</sup> The most recent review of medicine donations in 2009 found that a large proportion were not compliant with WHO guidelines because they were excessive, unnecessary, expired or otherwise inappropriate.<sup>4</sup> Emergency donations were less likely than long-term donations to comply with guidelines, and frequently had a short shelf life or inappropriate labeling.<sup>4</sup> This review found that the arrival of

large donations in quick succession overwhelmed local services with excessive quantities of medicines that expired before they could be used.<sup>4</sup> Another study found that improper disposal may result in environmental pollution, such as the leaching of pharmaceuticals into soil and water.<sup>1</sup>

Donations of medical devices, including healthcare and diagnostic equipment, may also be poorly executed. Although WHO *Medical device donations: considerations for solicitation and provision* (2011)<sup>8</sup> and WHO *Guidelines for Health Care Equipment Donations* (2009)<sup>9</sup> exist, little is known about the compliance of medical device donations with guidelines and recommendations. The donation of medical devices poses unique challenges. Medical technology is often designed for use in developed countries, and may therefore be inappropriate for limited resource settings that often lack access to parts needed for repair and maintenance, or trained personnel to maintain equipment for long-term use.<sup>10</sup>

This paper aims to update the previous review of medicine donations<sup>4</sup> and expand it to include device donations. We assess the adherence of identified medicine and medical device donations to the WHO *Guidelines for Medicine Donations*<sup>2</sup> and/or the WHO *Medical device donations: considerations for solicitation and provision*<sup>8</sup> and WHO *Guidelines for Health Care Equipment Donations*.<sup>9</sup>

## Materials and methods

In January 2018, we searched media, academic and gray literature, including industry and NGO documents, to identify journal articles, reports and media stories that described the donation of medication or medical devices. We worked with a librarian to develop a search strategy for PubMed based on the concepts 'medicine donation(s)' and 'device donation(s)', and adapted this for Embase, Scopus, and Factiva, a news database. We then conducted a snowball search using Google and/or Google Scholar for companies, products, events or programs associated with medicine or medical device donations that were identified in our initial search, including websites of pharmaceutical companies and NGOs.

We included case studies, news reports, press releases, journal articles (peer-reviewed or not) and company reports published in English that described specific incidences of the donation of pharmaceutical agent(s), medical device(s), assistive technologies, personal protective equipment, or diagnostic or screening tests. We included descriptions of donations made from January 2009 onwards in order to capture reports not identified in the previous review, or long-term donation programs continuing through 2009, regardless of commencement date. We excluded reports that contained insufficient information to compare the donation against any of the items in the WHO guidelines,<sup>2,8,9</sup> and reports on the donation of funds designated for the purchase of pharmaceuticals or devices.

One investigator screened titles and/or abstracts of retrieved records for possible inclusion. Two investigators then assessed the full text for eligibility. From each report, we extracted data on donation characteristics and compliance with WHO guidelines using RedCap, a secure web-based application for the collection and management of data.<sup>11</sup> Collected data included information

on selection, quality assurance and shelf life, presentation, packaging and labeling, and information and management.

We assessed compliance against the WHO's guidelines for medicine donations,<sup>2</sup> for healthcare equipment donations<sup>9</sup> and for medical device donation considerations.<sup>8</sup> Reports of donations were stratified by donation type (disaster-related, long-term, one-off or repeated) and items donated. We created a list of items to assess compliance with guidelines. For medicine donations, we used all of the articles included in the WHO guidelines verbatim.<sup>2</sup> We created a list of 11 items to assess device donation compliance that incorporated the requirements from both the WHO guidelines for healthcare equipment donations<sup>9</sup> and the WHO medical device donation considerations<sup>8</sup> (see supplementary file 1). We calculated the percentage of donations in compliance with the items in the WHO guidelines. Commonly reported barriers and facilitators to donations were extracted from the included reports and summarized. We report case examples of both good and poor compliance with guidelines for medicines and devices. Examples were chosen if they provided sufficient information to assess most of the guideline items and if they presented a clear example of good or poor compliance across the assessed guideline items.

## Results

Eighty-eight reports describing 53 separate donations were included, as shown in Figure 1. Table 1 summarizes the characteristics of the included reports. We identified 15 disaster donations, 15 long-term donation programs and 23 one-off or repeated donations. There were 29 reported medicine donations, 18 device donations and 6 mixed donations.

Of the 88 included reports, 29 were media reports or press releases, 27 were from academic journals, 18 were publications from NGOs. 12 were from pharmaceutical company websites, one was from a multilateral agency and one was a book chapter. The majority of the reports from academic journals were case studies (n=14) or evaluations of donations (n=3).

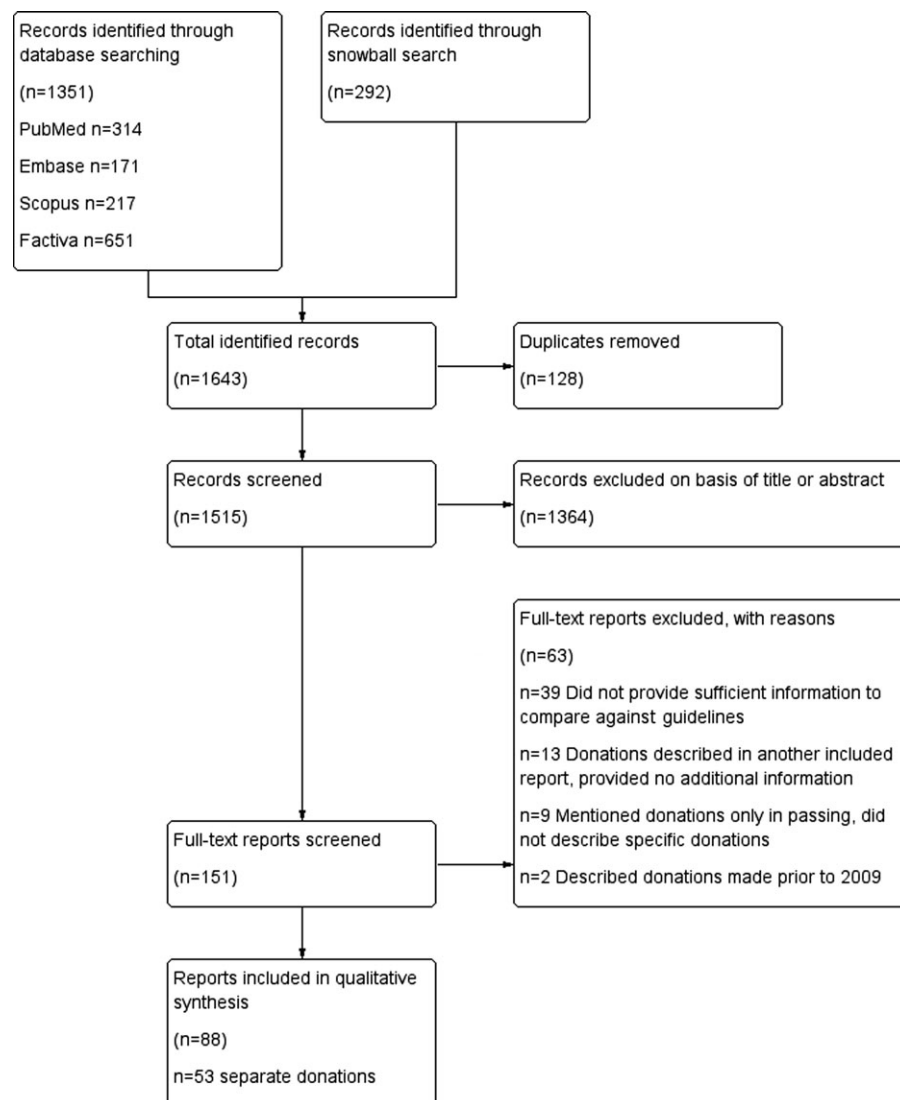
### Characteristics of donations

#### *Disaster-related donations*

Table 2 summarizes the characteristics of the disaster-related donations. There were eight incidences of medicine donations, including one donation of a traditional Chinese medicine, two donations of medical devices, and a combination of medicines and supplies following five disasters.

#### *Long-term donations*

The characteristics of 15 long-term medicine donation programs are shown in Table 3. Program length ranged from 3 to 31 y. There was only one long-term medical device donation, that being equipment and consumables to Rwanda for screening women for HPV during 2013–2016.<sup>21</sup> This donation was made in response to the donation of Gardasil for Rwanda's HPV vaccination program, and based on agreement among the donor, QIAGEN and the Rwandan Ministry of Health as part of a national program to vaccinate, screen and treat women against



**Figure 1.** Study flow diagram.

HPV and cervical cancer. Concessional pricing was offered following the end of the donation period.

#### *One-off and repeated donations*

Table 4 summarizes the characteristics of 23 cases of one-off or repeated donations. ‘Repeated donations’ refers to multiple donations made by the same donor to the same recipient, but not as part of a specific long-term program. Fifteen donations were for medical devices, seven were for medications and one donation included both.

#### **Compliance with donation guidelines**

Most donations did not comply with at least some items in the WHO guidelines, and no reports provided sufficient information to assess compliance against all items. Tables 5 and 6 show the

percentage of donations compliant with WHO guideline items for medicine and medical device donations, respectively. Table 7 provides a summary of common problems demonstrating lack of compliance with WHO guidelines for medicine and device donations. For each main category, examples are provided below (see also supplementary file 2).

#### **Selection of donated medicines or devices prior to donation**

‘Selection of donated medicines or devices’ refers to assessing the needs and distribution capacity of the recipient country. Excessive amounts of, or inappropriate, medicines were donated following disaster events. Some countries had to invest resources to store<sup>35</sup> or destroy medicines.<sup>27,31</sup> Following the 2010 earthquake in Haiti, the volume of donations overwhelmed the capabilities of Haitian hospitals and Programme

**Table 1.** Characteristics of included reports

| Author                                                    | Year | Title                                                                                                         | Publication type               | Donation type             | Donor                                                                             | Recipient                                                                                           | Item donated                                           |
|-----------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| African News Agency <sup>12</sup>                         | 2017 | China donates medical equipment to SA hospital                                                                | Media report                   | One-off donation          | Government, China                                                                 | Steve Biko Academic Hospital, Pretoria, South Africa                                                | Medical devices, equipment                             |
| African Press Organization <sup>13</sup>                  | 2012 | Tanzania/Merck To Intensify Support in the Fight Against Schistosomiasis in Tanzania                          | Media report                   | Long-term program         | Merck, pharmaceutical company                                                     | Tanzania                                                                                            | Medicine, Praziquantel                                 |
| All Africa <sup>14</sup>                                  | 2016 | State Receives Record Drug Donation to Fight Worm Disease                                                     | Media report                   | Long-term program         | Merck KGaA, pharmaceutical company                                                | Abuja, Nigeria                                                                                      | Medicine, Praziquantel                                 |
| American Medical Resources Foundation, Inc. <sup>15</sup> | 2013 | AMRF Equipment Donations Evaluated                                                                            | Publication from NGO           | One-off donation          | American Medical Resources Foundation, NGO                                        | ADENI hospital of Quetzaltenango; Santa Elena National Hospital of Santa Cruz del Quiche, Guatemala | Medical devices, equipment                             |
| Arie <sup>16</sup>                                        | 2010 | Medical supplies are trapped in Haitian ports as NGOs struggle with paperwork and delays                      | Academic journal               | Disaster-related donation | Bill Clinton Foundation, NGO                                                      | Haitian Society of Ophthalmology, Haiti                                                             | Medicine and medical devices, spectacles and eye drops |
| Arellano Maric et al. <sup>17</sup>                       | 2015 | Intermittent Noninvasive Ventilation at San José Hospital in Chile: Report of a German Donation               | Academic journal               | One-off donation          | Heinen und Löwenstein, medical device company                                     | San José NIV centre, Chile                                                                          | Medical devices                                        |
| Bayer <sup>18</sup>                                       | 2011 | Bayer Extends Support to Fight Chagas Disease                                                                 | Pharmaceutical company website | Long-term program         | Bayer healthcare pharmaceuticals, pharmaceutical company                          | Countries in Latin America                                                                          | Medicine, nifurtimox                                   |
| Bauserman et al. <sup>19</sup>                            | 2015 | Determining the utility and durability of medical equipment donated to a rural clinic in a low-income country | Academic journal               | One-off donation          | Rice University                                                                   | Takaya Health Centre, Democratic Republic of Congo                                                  | Medical devices                                        |
| Berkrot <sup>20</sup>                                     | 2018 | Biogen, Sobi pledge hemophilia drug donation in developing world                                              | Media report                   | Long-term program         | Biogen Idec Inc and partner Swedish Orphan Biovitrum AB, pharmaceutical companies | World Federation of Hemophilia, multiple countries                                                  | Medicine, Alprolix and Eloctate                        |

Continued

Table 1. Continued

| Author                                                        | Year | Title                                                                                                                                                                                          | Publication type               | Donation type             | Donor                                                                                 | Recipient                                                                       | Item donated                                                                       |
|---------------------------------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Binagwaho et al. <sup>21</sup>                                | 2013 | Integration of comprehensive women's health programmes into health systems: cervical cancer prevention, care and control in Rwanda                                                             | Academic journal               | Long-term program         | Merck & Co, pharmaceutical company<br>Qiagen                                          | Rwanda Ministry of Health, Rwanda                                               | Medicine, Gardasil<br>Medical devices, equipment and consumables for HPV screening |
| Boseley <sup>22</sup>                                         | 2010 | GSK to donate a billion tablets a year for neglected diseases                                                                                                                                  | Media report                   | Long-term program         | GSK, pharmaceutical company                                                           | Africa                                                                          | Medicine, Albendazole                                                              |
| Brack <sup>23</sup>                                           | 2015 | Needed Donated Medicines Arrive in Nepal                                                                                                                                                       | Publication from NGO           | Disaster-related donation | Project HOPE, NGO                                                                     | Ministry of Health, Nepal                                                       | Medicine and medical devices                                                       |
| Bradley et al. <sup>24</sup>                                  | 2016 | A study of medical equipment donations: recipient experiences                                                                                                                                  | Academic journal               | One-off donation          | Canadian NGOs                                                                         | Multiple hospitals, Ghana                                                       | Medical devices, equipment                                                         |
| BSR Healthcare <sup>25</sup>                                  | 2012 | Case Study: Collaboration Leprosy Donation Program                                                                                                                                             | Pharmaceutical company website | Long-term program         | Novartis, pharmaceutical company                                                      | Multiple                                                                        | Medicine, multidrug therapy for the treatment of leprosy                           |
| Burpee <sup>26</sup>                                          | 2014 | Why Uganda should regulate medical equipment                                                                                                                                                   | Media report                   | One-off donation          | Donor not specified                                                                   | Multiple hospitals, Uganda                                                      | Medical devices, equipment                                                         |
| Burns <sup>27</sup>                                           | 2010 | Rx for Humanitarian relief                                                                                                                                                                     | Media report                   | Disaster-related donation | Members of PQMD, pharmaceutical companies                                             | Haiti                                                                           | Medicine and medical devices                                                       |
| Bush & Hopkins <sup>28</sup>                                  | 2011 | Public-private partnerships in neglected tropical disease control: The role of nongovernmental organizations                                                                                   | Academic journal               | Long-term program         | Merck, pharmaceutical company                                                         | Primarily west African countries                                                | Medicine, Ivermectin                                                               |
| Cancer Weekly <sup>29</sup>                                   | 2015 | The Jack Brewer Foundation and Immune Therapeutics Inc. Announce Medical Equipment Donation Program for the Prevention of Cervical Cancer in Africa to be Unveiled Today at the United Nations | Media report                   | One-off donation          | Immune Therapeutics Inc., pharmaceutical company, and the Jack Brewer Foundation, NGO | Queen Elizabeth Central Hospital and clinics, Malawi                            | Medical devices, Wallach LLD100 Cryosurgical systems                               |
| Caribbean Media Corporation news agency website <sup>30</sup> | 2012 | Brazil makes drug donation to subregion                                                                                                                                                        | Media report                   | One-off donation          | Government, Brazil                                                                    | 9 member countries of the sub-regional Organization of Eastern Caribbean States | Medicine, antiretroviral medicines                                                 |

Continued

**Table 1.** *Continued*

| Author                                 | Year | Title                                                                                                                          | Publication type               | Donation type             | Donor                                                            | Recipient                                            | Item donated                                       |
|----------------------------------------|------|--------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------|------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------|
| Claycomb <sup>31</sup>                 | 2013 | Issues in emergency pharmacy                                                                                                   | Media report                   | Disaster-related donation | Donor not specified                                              | Japan                                                | Medicine, not specified                            |
| Cohen et al. <sup>32</sup>             | 2016 | Progress Report on Neglected Tropical Disease Drug Donation Programs                                                           | Academic journal               | Long-term program         | Pharmaceutical companies that signed the 2012 London Declaration | Multiple                                             | Medicine, not specified                            |
| Compton <sup>33</sup>                  | 2012 | Let's make donations more effective: don't waste these important efforts                                                       | Publication from NGO           | One-off donation          | Catholic health care organizations, NGOs                         | Not specified                                        | Medical devices, surplus                           |
| Cooper <sup>34</sup>                   | 2017 | Urgently needed hemophilia treatment drugs delivered to Puerto Rico pediatric hospital                                         | Publication from NGO           | Disaster-related donation | Bioverativ, pharmaceutical company                               | University Pediatric hospital, San Juan, Puerto Rico | Medicine, clotting factors                         |
| Cumming-Bruce <sup>35</sup>            | 2009 | WHO takes lead on health as UN tackles crises                                                                                  | Academic journal               | Disaster-related donation | 'Governments and organizations'                                  | Palestinian Ministry of Health, Gaza, Palestine      | Medical devices, supplies                          |
| Crump et al. <sup>36</sup>             | 2012 | The onchocerciasis chronicle: from the beginning to the end?                                                                   | Academic journal               | Long-term program         | Merck & Co, pharmaceutical company                               | Multiple                                             | Medicine, Ivermectin                               |
| de Ville de Goyet et al. <sup>37</sup> | 2010 | Health response to the earthquake in Haiti: Lessons to be learned for the next massive sudden-onset disaster                   | Report- multilateral agency    | Disaster-related donation | Donor not specified                                              | PROMESS, Haiti                                       | Medicine and medical devices                       |
| Direct Relief <sup>38</sup>            | 2009 | Direct Relief responding to dengue fever outbreak in Bolivia                                                                   | Publication from NGO           | Disaster-related donation | Direct relief, NGO                                               | Bolivia                                              | Medicine, including analgesics, antibiotics        |
| Dzwonczyk & Riha <sup>39</sup>         | 2012 | Medical equipment donations in Haiti: flaws in the donation process                                                            | Academic journal               | Disaster-related donation | No specific donors mentioned                                     | Hospitals, Haiti                                     | Medical devices, supplies                          |
| Eisai <sup>40</sup>                    | 2010 | EISAI to provide medicine to help the World Health Organization (WHO) combat Lymphatic Filariasis epidemic                     | Pharmaceutical company website | Long-term program         | Eisai, Pharmaceutical company                                    | WHO                                                  | Medicine, diethylcarbamazine citrate (DEC) tablets |
| Eisai <sup>41</sup>                    | 2013 | Eisai Begins Free Supply of DEC Tablets to Eliminate Lymphatic Filariasis -First Shipment Sent from Eisai's Vizag Plant, India | Pharmaceutical company website | Long-term program         | Eisai, pharmaceutical company                                    | WHO, Papua New Guinea, Kiribati, Tuvalu, Fiji        | Medicine, diethylcarbamazine citrate (DEC) tablets |

*Continued*

Table 1. Continued

| Author                                                        | Year | Title                                                                                                    | Publication type               | Donation type             | Donor                                        | Recipient                                                   | Item donated                                              |
|---------------------------------------------------------------|------|----------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------|----------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------|
| Eisai <sup>42</sup>                                           | 2016 | Creating Leaflet for DEC Tablets in Local Languages for Endemic Countries                                | Pharmaceutical company website | Long-term program         | Eisai, pharmaceutical company                | Endemic countries                                           | Medicine, diethylcarbamazine citrate (DEC) tablets        |
| Eisai <sup>43</sup>                                           | 2016 | DEC Project Managers' Efforts to Support Lymphatic Filariasis Elimination Activities in Indonesia        | Pharmaceutical company website | Long-term program         | Eisai, Pharmaceutical company                | WHO and Indonesia/LF endemic countries (esp. Asia)          | Medicine, diethylcarbamazine citrate (DEC) tablets.       |
| Escandor <sup>44</sup>                                        | 2014 | US-based NGO gives CamSur Php 172-M medical equipment                                                    | Media report                   | One-off donation          | World Medical Relief, NGO                    | District hospitals, Camarines Sur Province, the Philippines | Medical devices, equipment                                |
| Finch et al. <sup>45</sup>                                    | 2014 | Evaluation of a large-scale donation of Lifebox pulse oximeters to non-physician anaesthetists in Uganda | Academic journal               | One-off donation          | The Lifebox foundation, NGO                  | Uganda                                                      | Medical devices, oximeter                                 |
| Friends of Disabled Adults and Children (FODAC) <sup>46</sup> | 2010 | FODAC is collecting supplies for shipment to Haiti                                                       | Publication from NGO           | Disaster-related donation | Friends of Disabled Adults and Children, NGO | Haiti                                                       | Medical devices, supplies                                 |
| Global Links <sup>47</sup>                                    | 2014 | Global Links responds to cholera outbreak in Haiti                                                       | Press release                  | Disaster-related donation | Global Links, NGO                            | PAHO, Haiti                                                 | Medical devices, medical supplies and equipment           |
| Gustavsen et al. <sup>48</sup>                                | 2009 | GlaxoSmithKline and Merck: private-sector collaboration for the elimination of lymphatic filariasis      | Academic journal               | Long-term program         | Merck, GSK, pharmaceutical companies         | >80 countries with endemic lymphatic filariasis             | Medicine, Albendazole and Ivermectin                      |
| Hammerli <sup>49</sup>                                        | 2017 | Children's Hospital in Cuba Receives 2nd Shipment of Medicines & Supplies                                | Publication from NGO           | One-off donation          | Heart to Heart International, NGO            | William Soler Pediatric Hospital, Cuba                      | Medicine and medical devices                              |
| Health Partners International of Canada <sup>50</sup>         | 2009 | World Vision, HPIC airlifts \$4 million cholera medications to Zimbabwe                                  | Publication from NGO           | Disaster-related donation | Health Partners International of Canada, NGO | Zimbabwe                                                    | Medicine, including rehydration solutions and antibiotics |
| Hoang <sup>51</sup>                                           | 2015 | Vietnamese customs explains disposal of cancer drug                                                      | Media report                   | One-off donation          | Novartis Pharma AG, pharmaceutical company   | HCMC Hospital of Hematology and Blood Transfusion, Vietnam  | Medicine, oncology                                        |

Continued



Table 1. Continued

| Author                                                 | Year | Title                                                                                                                                                 | Publication type     | Donation type             | Donor                                         | Recipient                                                    | Item donated                                                   |
|--------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------------|-----------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------|
| Hopkins <sup>52</sup>                                  | 2012 | Beyond Providing Drugs: the Mectizan donation stimulates new strategies in service delivery and in strengthening health systems                       | Academic journal     | Long-term program         | Merck & Co Inc. (MSD), pharmaceutical company | Multiple                                                     | Medicine, Ivermectin                                           |
| Hower & Garcia <sup>53</sup>                           | 2010 | Global Links Takes on Coordination of Local Haiti Response Effort                                                                                     | Publication from NGO | Disaster-related donation | Global Links, NGO                             | Hospital Albert Schweitzer, Haiti                            | Medicine and medical devices, including antibiotics            |
| International Health Partners <sup>54</sup>            | 2017 | Thank you from Egypt                                                                                                                                  | Publication from NGO | One-off donation          | International Health Partners, NGO            | Om El Masryen Hospital, Egypt                                | Medicine, including antibiotics, antifungal drugs, painkillers |
| International Organization for Migration <sup>55</sup> | 2017 | UN Migration Agency Supports Yemen's Struggling Health Care System                                                                                    | Press release        | Disaster-related donation | UN Migration Agency, multilateral agency      | Al-Jumhori Hospital in Sana'a, Yemen                         | Medicine and medical devices                                   |
| Janssen <sup>56</sup>                                  | 2013 | Janssen, the Pharmaceutical Companies of Johnson & Johnson, Announces First-of-its-Kind Drug Donation Program for HIV Treatment-Experienced Children  | Press release        | Long-term program         | Janssen, pharmaceutical company               | Ministry of Health in eligible countries, sub-Saharan Africa | Medicine, Darunavir and Etravirine                             |
| Jobe <sup>57</sup>                                     | 2010 | Disaster relief in post-earthquake Haiti: unintended consequences of humanitarian volunteerism                                                        | Academic journal     | Disaster-related donation | Donor not specified                           | Haiti                                                        | Medicine, not specified                                        |
| Katabaazi Nakyanzi et al. <sup>58</sup>                | 2010 | Expiry of medicines in supply outlets in Uganda                                                                                                       | Academic journal     | One-off donation          | Donor not specified                           | Uganda                                                       | Medicine, not specified                                        |
| Koporc et al. <sup>59</sup>                            | 2015 | Assessing 'First Mile' Supply Chain Factors Affecting Timeliness of School-Based Deworming Interventions: Supply and Logistics Performance Indicators | Academic journal     | Long-term program         | Johnson & Johnson, pharmaceutical company     | Multiple                                                     | Medicine, Mebendazole                                          |
| Ladner et al. <sup>60</sup>                            | 2013 | Prevention of mother-to-child HIV transmission in resource-limited settings: assessment of 99 Viramune Donation Programmes in 34 countries, 2000-2011 | Academic journal     | Long-term program         | Boehringer Ingelheim, pharmaceutical company  | Recipients in 60 countries                                   | Medicine, Nevirapine                                           |

Continued



Table 1. Continued

| Author                                  | Year | Title                                                                                                                                                                                                                                            | Publication type               | Donation type             | Donor                                                                      | Recipient                                                                    | Item donated                                      |
|-----------------------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------------------|---------------------------------------------------|
| Lauffenburger et al. <sup>61</sup>      | 2011 | A public-health approach to site-specific formulary management: addressing deficient drug supplies in Malawi                                                                                                                                     | Academic journal               | One-off donation          | Donor not specified                                                        | Outpatient medical clinic, Malawi                                            | Medicine, not specified                           |
| Lyatuu <sup>62</sup>                    | 2015 | Coca-Cola, Medshare Give Kamuli Hospital Shs 1.4 Billion Equipment                                                                                                                                                                               | Media report                   | One-off donation          | Coca-Cola Beverages Africa in partnership with Medshare International, NGO | Hospitals in Uganda                                                          | Medical devices, medical supplies and consumables |
| Lynch <sup>63</sup>                     | 2010 | Haiti's humanitarian aid disaster                                                                                                                                                                                                                | Media report                   | Disaster-related donation | Donor not specified                                                        | Haiti                                                                        | Medicine, not specified                           |
| Mackenzie et al. <sup>64</sup>          | 2012 | Elimination of onchocerciasis from Africa: Possible?                                                                                                                                                                                             | Academic journal               | Long-term program         | Merck & Co                                                                 | Countries in Africa and Latin America (the paper mainly focuses on Africa)   | Medicine, Ivermectin                              |
| Malaria Weekly <sup>65</sup>            | 2015 | Investigators at Johnson & Johnson Discuss Findings in Tropical Medicine and Public Health (Assessing 'First Mile' Supply Chain Factors Affecting Timeliness of School-Based Deworming Interventions: Supply and Logistics Performance Indicator | Media report                   | Long-term program         | Johnson & Johnson, pharmaceutical company                                  | 14 countries                                                                 | Medicine, Mebendazole                             |
| Manne et al. <sup>66</sup>              | 2013 | Barriers to Treatment Access for Chagas Disease in Mexico                                                                                                                                                                                        | Academic journal               | Long-term program         | Bayer, pharmaceutical company, and WHO, multilateral agency                | National Program on Onchocerciasis, Leishmaniasis and Chagas Disease, Mexico | Medicine, Nifurtimox                              |
| Mectizan Donation Program <sup>67</sup> | 2017 | Guide for Donations of Mectizan® to Accelerate the Elimination of Lymphatic Filariasis in Countries where Onchocerciasis is not co-endemic                                                                                                       | Pharmaceutical company website | Long-term program         | Merck & Co Inc. (MSD), pharmaceutical company                              | Ministry of Health of recipient countries                                    | Medicine, Ivermectin                              |

Continued

**Table 1.** *Continued*

| Author                    | Year | Title                                                                                                                                          | Publication type               | Donation type             | Donor                                             | Recipient                                      | Item donated                                              |
|---------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------|---------------------------------------------------|------------------------------------------------|-----------------------------------------------------------|
| Mena Report <sup>68</sup> | 2014 | Fiji: Health sector receives timely donation from Turkish government                                                                           | Media report                   | One-off donation          | Government, Turkey                                | Ministry of Health and medical services, Fiji  | Medical devices, equipment                                |
| Miesen <sup>69</sup>      | 2013 | The Inadequacy of Donating Medical Devices to Africa                                                                                           | Media report                   | One-off donation          | Donor not specified                               | Multiple hospitals, Uganda                     | Medical devices                                           |
| Morain <sup>70</sup>      | 2015 | Nepal Earthquake Response: Update 5/5                                                                                                          | Publication from NGO           | Disaster-related donation | Direct relief, NGO                                | Nepal                                          | Medicine and medical devices                              |
| Morain <sup>71</sup>      | 2017 | Direct Relief Airlifts 79,365 lbs of Emergency Medical Aid to Puerto Rico                                                                      | Publication from NGO           | Disaster-related donation | Direct relief, NGO                                | Department of Health, Puerto Rico              | Medicine and medical devices                              |
| Mugini <sup>72</sup>      | 2015 | Medical equipment donation to benefit Nyerere Hospital                                                                                         | Media report                   | One-off donation          | MATTER, NGO                                       | Nyerere District Designated Hospital, Tanzania | Medical devices                                           |
| Nair <sup>73</sup>        | 2017 | Novartis and The Max Foundation to provide cancer access programme in lower-income countries                                                   | Media report                   | Long-term program         | Novartis, pharmaceutical company                  | Low-income countries                           | Medicine, Imatinib                                        |
| Novartis <sup>74</sup>    | 2009 | Novartis Delivers 250,000,000th Coartem <sup>®</sup> Treatment And Becomes First Healthcare Company To Join United Against Malaria Partnership | Pharmaceutical company website | Long-term program         | Novartis, pharmaceutical company                  | Tanzania, other                                | Medicine, Artemisinin-based combination therapy           |
| Novartis <sup>75</sup>    | 2017 | Press release: Novartis and The Max Foundation transform pioneering cancer access program for people in lower-income countries                 | Press release                  | Long-term program         | Novartis, pharmaceutical company                  | Lower income countries                         | Medicine, Imatinib, Nilotinib                             |
| Novartis <sup>76</sup>    | 2018 | Novartis extends commitment to help achieve final elimination of leprosy                                                                       | Press release                  | Long-term program         | Novartis International AG, pharmaceutical company | Worldwide                                      | Medicine, multidrug therapy for the treatment of leprosy  |
| Parsons <sup>77</sup>     | 2013 | 30 Pallets of Essential Medicine for the Philippines on board Air Canada flight                                                                | Publication from NGO           | Disaster-related donation | Health Partners International of Canada, NGO      | Philippines                                    | Medicine, not specified                                   |
| Parsons <sup>78</sup>     | 2016 | \$1.74 million Worth of Apotex Medicine Being Airlifted to Ecuador                                                                             | Publication from NGO           | Disaster-related donation | Apotex, pharmaceutical company                    | Ministry of Health, Ecuador                    | Medicine, including antibiotics, analgesics, antifungals, |

*Continued*

Table 1. Continued

| Author                                 | Year | Title                                                                                                           | Publication type               | Donation type             | Donor                                                                    | Recipient                                                | Item donated                                                                                                         |
|----------------------------------------|------|-----------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------|--------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| Partnow & Stuteville <sup>79</sup>     | 2014 | Drug recycling: crime or compassion?                                                                            | Media report                   | One-off donation          | Salaam Cultural Museum, NGO                                              | Jordan                                                   | antihypertensives – medicines for diabetes, antianxiety medications, eye drops, antihistamines<br>Medicine, recycled |
| Pharmaceutical Journal <sup>80</sup>   | 2018 | Janssen provides free courses of anti-TB drug bedaquiline                                                       | Media report                   | Long-term program         | Janssen therapeutics, pharmaceutical company                             | National center for TB and lung diseases, Georgia        | Medicine, Bedaquiline                                                                                                |
| Pharma business week <sup>81</sup>     | 2010 | Sanomedics International Holdings; Sanomedics Supports Haiti Relief with Significant Medical Equipment Donation | Media report                   | Disaster-related donation | Sanomedics International Holdings, medical device company                | Haiti                                                    | Medical devices, thermometers                                                                                        |
| The Philippine Star <sup>82</sup>      | 2014 | Novartis, DOH vow to hasten progress in leprosy control                                                         | Media report                   | Long-term program         | Novartis, pharmaceutical company                                         | Department of Health                                     | Medicine, multidrug therapy for the treatment of leprosy                                                             |
| Robles et al. <sup>83</sup>            | 2010 | Customs stalling aid efforts in Haiti                                                                           | Publication from NGO           | Disaster-related donation | Granted wish foundation, NGO                                             | Haiti                                                    | Medical devices, ambulance, mobile medical unit                                                                      |
| Ryley <sup>84</sup>                    | 2010 | Haitian Hospitals Awash With Supplies, Struggle to Pay Staff (Part 2)                                           | Media report                   | Disaster-related donation | Donor not specified                                                      | Hospitals, Haiti                                         | Medical devices, supplies                                                                                            |
| Salenga et al. <sup>85</sup>           | 2015 | Medicines management in the Philippine public sector during the response to Haiyan                              | Academic journal               | Disaster-related donation | Donor not specified                                                      | Philippines                                              | Medicine, not specified                                                                                              |
| Sanofi Espoir Foundation <sup>86</sup> | 2011 | Humanitarian emergencies in Côte d'Ivoire and Libya                                                             | Pharmaceutical company website | Disaster-related donation | Sanofi Espoir Foundation, pharmaceutical companies                       | Hospitals, Cote d'Ivoire and Libya                       | Medicine, not specified                                                                                              |
| Sanofi Espoir Foundation <sup>87</sup> | 2011 | Humanitarian emergencies in Pakistan, Thailand and Turkey                                                       | Pharmaceutical company website | Disaster-related donation | Sanofi Espoir Foundation, pharmaceutical companies charitable subsidiary | Ministry of Health, Pakistan                             | Medicine, Chloroquine                                                                                                |
| Sanofi Espoir foundation <sup>88</sup> | 2012 | Solidarity with the people of Haiti following the passage of cyclone Matthew                                    | Pharmaceutical company website | Disaster-related donation | Sanofi and Zentiva, pharmaceutical companies                             | French Red Cross, Première Urgence Internationale, Haiti | Medicine, not specified                                                                                              |

Continued

**Table 1.** *Continued*

| Author                               | Year | Title                                                                                                                                                         | Publication type               | Donation type             | Donor                                                                                                            | Recipient                                      | Item donated                                                                                                                   |
|--------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------|------------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Samsky <sup>89</sup>                 | 2012 | Scientific sovereignty: how international drug donation programs reshape health, disease, and the state                                                       | Academic journal               | Long-term program         | Merck, Pfizer, pharmaceutical companies                                                                          | Tanzania                                       | Medicine, Ivermectin, Zithromax                                                                                                |
| Samsky <sup>90</sup>                 | 2015 | The drug swallows: Scientific sovereignty and pharmaceuticalization in two international drug donation programs                                               | Book chapter                   | Long-term program         | Merck, Pfizer, pharmaceutical companies                                                                          | Tanzania                                       | Medicine, Ivermectin, Zithromax                                                                                                |
| Savioli et al. <sup>91</sup>         | 2017 | Building a global schistosomiasis alliance: An opportunity to join forces to fight inequality and rural poverty                                               | Academic journal               | Long-term program         | Merck, pharmaceutical company                                                                                    | Sub-Saharan Africa                             | Medicine, Praziquantel                                                                                                         |
| Smith <sup>92</sup>                  | 2017 | Responding to devastation in Puerto Rico                                                                                                                      | Pharmaceutical company website | Disaster-related donation | Lilly, pharmaceutical company                                                                                    | Department of Health, Puerto Rico              | Medicine and medical devices, including insulin                                                                                |
| Sumner et al. <sup>93</sup>          | 2017 | Wheelchair donation in a low-resources setting: Utilization, challenges and benefits of wheelchairs provided through a specialized setting programme in Haiti | Academic journal               | One-off donation          | Team Canada Healing Hands, NGO                                                                                   | Local rehabilitation program in northern Haiti | Medical devices, wheelchairs                                                                                                   |
| Tekinturhan et al. <sup>94</sup>     | 2013 | Improving access to care in low and middle-income countries: institutional factors related to enrollment and patient outcome in a cancer drug access program  | Academic journal               | Long-term program         | Novartis, pharmaceutical company                                                                                 | 47 institutions in 44 countries                | Medicine, Imatinib                                                                                                             |
| US Department of State <sup>95</sup> | 2009 | Project Hope and U.S. Government deliver medical assistance for Tajik hospitals                                                                               | Publication from NGO           | One-off donation          | McNeil, GlaxoSmithKline, Alcon, Hospira, Abbott, Schering Plough and Johnson & Johnson, pharmaceutical companies | Health centers, Tajikistan                     | Medicine, including oncology, cardiovascular, antiviral and psychiatry drugs, ophthalmology and skin medicines and antibiotics |

*Continued*

**Table 1.** *Continued*

| Author                               | Year | Title                                                                                                                  | Publication type     | Donation type             | Donor                                                                                          | Recipient                                                      | Item donated                                                                                                                                              |
|--------------------------------------|------|------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------------|------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| US Department of State <sup>96</sup> | 2009 | Tajikistan: Project HOPE delivers \$7.9 million of medical supplies to Tajik hospitals                                 | Publication from NGO | One-off donation          | Eli Lilly, Merck, GlaxoSmithKline, Alcon, Hospira and Janssen Cilaq, pharmaceutical companies  | Hospitals and health centers, Tajikistan                       | Medicine, including insulin, antivirals, antibiotics, oncology medicines, cardiovascular medications, psychiatric medications and ophthalmology medicines |
| US Department of State <sup>97</sup> | 2011 | U.S. embassy delivers \$35 million in donated medicine to Tajikistan                                                   | Publication from NGO | One-off donation          | GlaxoSmithKline, Abbott, Lundbeck, Merck, Hospira, Allergan and other pharmaceutical companies | Ministry of Health, clinics and hospitals, Tajikistan          | Medicine, including antibiotics, and oncological, cardiological and psychiatric medication                                                                |
| Wan et al. <sup>98</sup>             | 2015 | Global public health impact of recovered supplies from operating rooms: a critical analysis with national implications | Academic journal     | One-off donation          | SHARE, NGO                                                                                     | The Luis Vernaza Hospital and Damian House, Guayaquil, Ecuador | Medical devices, surgical equipment                                                                                                                       |
| Zhang et al. <sup>99</sup>           | 2015 | Why West Africa rejected donation of Chinese medicine for treating Ebola recommended by Chinese government?            | Academic journal     | Disaster-related donation | Government, China                                                                              | West African countries                                         | Traditional Chinese medicine, Pien Tze Huang                                                                                                              |

**Table 2.** Characteristics of disaster-related donations (n=15)

| Disaster                                               | Medicine(s)/device(s)                                                                                                                                                | Location               | Year | Donor                                                      |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------|------------------------------------------------------------|
| Dengue fever outbreak <sup>38</sup>                    | Medicines including analgesics and antibiotics                                                                                                                       | Bolivia                | 2009 | Direct Relief                                              |
| Cholera outbreak <sup>50</sup>                         | Medicines for the management of cholera                                                                                                                              | Zimbabwe               | 2009 | Health Partners International of Canada                    |
| Conflict <sup>35</sup>                                 | Medical supplies                                                                                                                                                     | Gaza                   | 2009 | 'Governments and organizations'                            |
| Earthquake <sup>16,27,37,39,46,53,57,63,81,83,84</sup> | Various medicines and medical supplies:<br>- 483 091 kg of pharmaceutical supplies and 4990 kg of medical supplies were sent in the 2 weeks following the earthquake | Haiti                  | 2010 | Various <sup>a</sup>                                       |
| Cholera outbreak <sup>47</sup>                         | Medical devices, including IV poles                                                                                                                                  | Haiti                  | 2010 | Global Links                                               |
| Flood <sup>87</sup>                                    | Medicines<br>- 3800 boxes of antimalarial medication (Nivaquine)                                                                                                     | Pakistan               | 2011 | Sanofi Espoir Foundation                                   |
| Tsunami, earthquake <sup>31</sup>                      | Medicines                                                                                                                                                            | Japan                  | 2011 | Not specified                                              |
| Conflict <sup>86</sup>                                 | Healthcare kits Emergency medicine kits                                                                                                                              | Cote d'Ivoire<br>Libya | 2011 | Sanofi Espoir Foundation                                   |
| Typhoon <sup>77,85</sup>                               | Medicines<br>- 30 pallets medicines<br>- Unspecified medicines                                                                                                       | Philippines            | 2013 | Health Partners International of Canada, unspecified donor |
| Earthquake <sup>23,70</sup>                            | Medical supplies and medicines<br>- X-ray units, ventilators, orthopedic supplies, IV solutions, medications and 5 'hospital modules'<br>- unspecified supplies      | Nepal                  | 2015 | Direct Relief, Project Hope                                |
| Ebola outbreak <sup>99</sup>                           | Pien Tze Huang (traditional Chinese medicine) for treatment of Ebola (rejected)                                                                                      | West Africa            | 2015 | Chinese government                                         |
| Earthquake <sup>78</sup>                               | Medicines                                                                                                                                                            | Ecuador                | 2016 | Apotex                                                     |
| Hurricane <sup>88</sup>                                | Medicines<br>Paracetamol                                                                                                                                             | Haiti                  | 2016 | Sanofi<br>Zentiva                                          |
| Hurricane <sup>34,71,92</sup>                          | Medicines, medical supplies<br>- 79 365 lb medical aid (prescription medications, nutritional and medical supplies)                                                  | Puerto Rico            | 2017 | Direct Relief                                              |
| Conflict <sup>55</sup>                                 | Medicines, medical supplies                                                                                                                                          | Yemen                  | 2017 | UN migration agency                                        |

<sup>a</sup>Global Links, members of Partnership for Quality Medical Donations (PQMD), Bill Clinton Foundation, Friends of Disabled Adults and Children, Granted Wish Foundation, Sandomedics International Holdings.

de Médicaments Essentiels (PROMESS),<sup>57</sup> a medicines distribution agency managed by the Pan American Health Organization (PAHO). PROMESS distributed 345 000 boxes of essential medicines in the first 45 d following the earthquake.<sup>37</sup>

Some pharmaceutical donations following disasters were matched to recipients' needs. Some donors reached agreement with the recipient prior to making the donation,<sup>78</sup> or responded to direct requests for specific medications.<sup>34,90,91</sup> In one-off non-disaster-related donations, some medication and device donations were also in response to expressed needs.<sup>17,19,49,69,78,95</sup> Donations that involved communication between donor and recipient, or collaboration with experienced NGOs,<sup>33</sup> were more compliant with the WHO guidelines, appeared more useful and were more likely to suit the recipient's needs. However, medical device donations were commonly inappropriate for resource-limited settings, particularly in relation to energy requirements.<sup>16,39</sup>

Long-term programs generally required applications from recipients and were prioritized for areas endemic for the targeted disease. Applications required evidence that the recipient had the resources to distribute the medication.

### Quality assurance and shelf life

Medicines were donated that were therapeutic classes or formulations uncommon in the recipient country,<sup>61</sup> arrived without labeling, had expired<sup>52,59</sup> or had a short shelf life on arrival.<sup>51,85</sup> The source of some medicines was unclear, making it difficult to determine if they were counterfeit.<sup>31</sup> Excessive donations made sorting and quality assurance a challenge.<sup>57,85</sup> Medicines for long-term programs were more compliant with quality assurance and shelf-life guidelines because they were often manufactured specifically for these donations. In response to the

**Table 3.** Characteristics of long-term medicine donation programs (n=5)

| Generic medicine                                          | Brand name | Disease                                           | Donor             |
|-----------------------------------------------------------|------------|---------------------------------------------------|-------------------|
| HPV <sup>21</sup>                                         | Gardasil   | Vaccination against HPV infection                 | Merck             |
| Ivermectin <sup>28,32,36,52,64,67,89,90</sup>             | Mectizan   | Onchocerciasis                                    | Merck             |
|                                                           |            | Lymphatic filariasis                              |                   |
| Darunavir                                                 | Prezista   | HIV (second- and third-line treatment)            | Janssen           |
| Etravirine <sup>56</sup>                                  | Intelence  |                                                   |                   |
| artemisinin-based combination therapy (ACT) <sup>74</sup> | Coartem    | Malaria                                           | Novartis          |
| diethylcarbamazine citrate (DEC) <sup>32,40-43</sup>      |            | Lymphatic filariasis                              | Eisai             |
| Imatinib                                                  | Glivec     | Chronic myeloid leukaemia (CML), gastrointestinal | Novartis          |
| Nilotinib (second-line treatment) <sup>64,66,73</sup>     | Tasigna    | stromal tumors (GIST) and other rare cancers      |                   |
| Albendazole <sup>46,49,55</sup>                           |            | Intestinal worms/soil-transmitted helminthiasis,  | GSK               |
|                                                           |            | lymphatic filariasis                              |                   |
| Mebendazole <sup>49,58,61</sup>                           | Vermox     | Soil-transmitted helminthiasis                    | Johnson & Johnson |
| Nevirapine <sup>60</sup>                                  | Viramune   | Prevention of mother-to-child transmission of HIV | Johnson & Johnson |
| MDT <sup>a25,32,76,82</sup>                               |            | Leprosy                                           | Novartis          |
| Nifurtimox <sup>18,66</sup>                               | Lampit     | Chagas disease                                    | Bayer             |
| Praziquantel <sup>13,14,91</sup>                          | Biltricide | Schistosomiasis                                   | Merck             |
| Azithromycin <sup>32,89,90</sup>                          | Zithromax  | Trachoma                                          | Pfizer            |
| Bedaquiline <sup>80</sup>                                 | Sirturo    | Multidrug-resistant TB                            | Janssen           |
| Coagulation factor IX <sup>20</sup>                       | Alprolix   | Haemophilia B                                     | Biogen and Sobi   |
| Antihemophilic factor (recombinant)                       | Eloctate   | Haemophilia A                                     |                   |

<sup>a</sup>MDT, multidrug therapy (rifampicin, clofazimine and dapson).

Ebola outbreak in West Africa in 2015, the Chinese government offered donations of Pien Tze Huang, a traditional Chinese medicine,<sup>99</sup> which was rejected due to insufficient evidence of an antiviral effect, reported adverse events and ingredients from an endangered species.

Surplus supplies were a common source of medical device donations. Devices that were non-functional, or posed an environmental or health hazard, were donated.<sup>39</sup> Donations commonly arrived without all required parts to operate or repair devices, recipients were unable to access consumables or spare parts locally for obsolete equipment<sup>26,39</sup> and lacked maintenance or instruction manuals in local languages.<sup>33,38,58</sup>

### Presentation, packaging and labeling

No information was available about the language of labeling for most donations. The active ingredients of some medications donated to Japan in 2011 could not be determined as the packaging was in unfamiliar languages.<sup>31</sup> In compliance with one guideline item Eisai produces brochures on diethylcarbamazine citrate for health professionals in languages common in endemic countries.<sup>42</sup> Multidrug therapy donations by Novartis for the treatment of Leprosy are packaged in fixed-dose blister packages,<sup>32</sup> while Nevirapine (Johnson & Johnson), is provided in individual take-home packages for patients, reducing the potential for wastage.<sup>60</sup>

### Information and management of the donation process

'Information and management' refers to the shipment of donations and management afterwards. Generally, shipment to recipient countries was arranged by the donor. Within-country distribution and logistics were in some cases facilitated by NGOs or multilateral agencies following disasters<sup>27,57,77,97</sup> and in long-term programs,<sup>32,52,89</sup> but otherwise were the responsibility of the recipient.

Transportation to landlocked countries was challenging as donations had to move through two or more countries' customs clearances to get from port to recipient.<sup>59</sup> Delays in customs clearance occurred due to incorrect paperwork, or failure by donors to prove tax-free status.<sup>16</sup> Medical device donations rarely involved training for healthcare workers, which resulted in devices remaining unused,<sup>39,69</sup> and non-functional devices created storage challenges for the recipients.<sup>33</sup>

### Case example: good compliance with medicine donation guidelines<sup>59</sup>

Johnson & Johnson have donated mebendazole for the control of soil-transmitted helminthiasis since 2007. Distribution and technical support were facilitated by Children without Worms (CWW) from 2007 to 2012. From 2013 onwards, overview of the donation program was transferred to the WHO with continued involvement from CWW. Applications for the program included information about disease burden, proposed medicine distribution, training, and monitoring and evaluation, to ensure endemic areas were



**Table 4.** Characteristics of one-time or repeated donations of medicine or devices (n=23)

| Medicine/device                                                                                                                                                             | Recipient                                | Year                | Donor                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------------------|------------------------------------------------------------------------|
| <b>Medicine</b>                                                                                                                                                             |                                          |                     |                                                                        |
| Antiviral medicines (for the treatment of HIV) <sup>30</sup>                                                                                                                | Organization of Eastern Caribbean States | 2012                | Brazil                                                                 |
| Three donations of medicines (antiviral, psychiatric medicines, cardiovascular medicines, antibiotics, insulin) <sup>95-97</sup>                                            | Tajikistan                               | 2009, 2011          | Project Hope, US Department of State                                   |
| Medicines, including antibiotics, antifungals, painkillers, diabetic medications <sup>54</sup>                                                                              | Egypt                                    | 2017                | International Health Partners                                          |
| Cancer medicines <sup>51</sup>                                                                                                                                              | Vietnam                                  | 2015                | Novartis                                                               |
| Medicines close to expiry, recycled medications <sup>79</sup>                                                                                                               | Refugee camps in Jordan                  | 2014                | Salaam Cultural Museum                                                 |
| Unspecified medicines <sup>58</sup>                                                                                                                                         | Uganda                                   | 2010                | Various <sup>a</sup>                                                   |
| Unspecified medicines <sup>61</sup>                                                                                                                                         | Outpatient clinic in Malawi              | Not specified       | Various <sup>a</sup>                                                   |
| <b>Devices and medicine</b>                                                                                                                                                 |                                          |                     |                                                                        |
| Medicines and medical devices <sup>49</sup>                                                                                                                                 | William Soler Pediatric Hospital, Cuba   | 2015, 2017          | Heart to Heart International                                           |
| <b>Medical devices</b>                                                                                                                                                      |                                          |                     |                                                                        |
| Medical devices, including consumables, imaging equipment, dental devices, life-support equipment and other medical supplies <sup>24</sup>                                  | Health facilities in Ghana               | Not specified       | Various <sup>a</sup>                                                   |
| Medical devices, including 5 bed central station ICU monitoring system, microscopes, centrifuges and sterilizer <sup>15</sup>                                               | Guatemala                                | 2013                | American Medical Resources Foundation                                  |
| Second-hand ventilators, masks and tubing systems <sup>17</sup>                                                                                                             | Chile                                    | 2014                | Heinen und Löwenstein                                                  |
| Diagnostic equipment <sup>19</sup>                                                                                                                                          | Democratic Republic of Congo             | 2012                | Rice University                                                        |
| Medical devices, including X-ray endoscopy, oxygen concentrator, C-Arm fluoroscopy machine, dialysis machines and two 'slightly used' ambulances <sup>44</sup>              | Camarines Sur, Philippines               | 2014                | World Medical Relief                                                   |
| Medical devices including imaging equipment, patient monitors, ventilators and an anesthesia workstation <sup>12</sup>                                                      | Steve Biko Academic Hospital, Pretoria   | 2017                | China                                                                  |
| Medical surplus <sup>33</sup>                                                                                                                                               | CHA member hospitals                     | Not specified       | CHA                                                                    |
| 5 ECG machines, 5 vital-signs monitors and 12 scales worth US\$25 000 <sup>68</sup>                                                                                         | Fiji                                     | 2014                | Turkey                                                                 |
| Handheld pulse oximeters <sup>45</sup>                                                                                                                                      | Uganda                                   | 2011                | The LifeBox Foundation                                                 |
| Medical devices and consumables, including Intensive Care Unit beds, ultrasound machine, incubators, delivery sets, oxygen concentrators and anesthetics unit <sup>62</sup> | Uganda                                   | 2016                | Coca-Cola Beverages Africa, in partnership with Medshare International |
| Wallach LL100 Cryosurgical systems for the treatment of cervical cancer <sup>29</sup>                                                                                       | Malawi                                   | 2010                | Jack Brewer                                                            |
| Medical devices including ultrasound machines, microscopes and beds <sup>72</sup>                                                                                           | Nyerere                                  | 2015                | MATTER                                                                 |
| Wheelchairs <sup>93</sup>                                                                                                                                                   | Haiti                                    | 2014                | Team Canada Healing Hands                                              |
| Medical devices, including incubators and anesthetic machines <sup>26,69</sup>                                                                                              | Hospitals in Uganda                      | 2014, prior to 2013 | Various <sup>a</sup>                                                   |
| Recovered supplies <sup>98</sup>                                                                                                                                            | Ecuador                                  | 2010-2013           | SHARE                                                                  |

<sup>a</sup>Specific donors not stated.

**Table 5.** Percentage of medicine donations compliant with guideline items

| Guideline item                                                                                                                                                                                                                       | Number of donations that met guideline item | Number that reported on compliance | Percentage (%) compliant with guideline item |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------------------------------|----------------------------------------------|
| 1.1. Is the donation based on an expressed need from the recipient?                                                                                                                                                                  | 25                                          | 29                                 | 86.2                                         |
| 1.2 Is the donation relevant to the disease pattern of the recipient country?                                                                                                                                                        | 27                                          | 28                                 | 96.4                                         |
| 1.3 Were the donation quantities agreed upon between the donor and recipient?                                                                                                                                                        | 12                                          | 17                                 | 70.6                                         |
| 2.1 Are the donated medicines or their generic equivalents approved for use in the recipient country?                                                                                                                                | 7                                           | 10                                 | 70.0                                         |
| 2.2 Do the donated medicines or their generic equivalents appear on the national list of essential medicines, national standard treatment guidelines or the WHO model lists of essential medicines if no national list is available? | 2                                           | 4                                  | 50.0                                         |
| 2.3. If 'no' to question 2.2, was the donation specifically requested by the recipient?                                                                                                                                              | 1                                           | 1                                  | 100.0                                        |
| 3.1 Is the presentation, strength, and formulation of the donation similar to those of medicines commonly used in the recipient country?                                                                                             | 0                                           | 3                                  | 0.0                                          |
| 4.1 Was the donation obtained from a quality-ensured source?                                                                                                                                                                         | 26                                          | 28                                 | 92.9                                         |
| 4.2 Does the donation comply with quality standards of the donor country?                                                                                                                                                            | 0                                           | 1                                  | 0.0                                          |
| 4.3 Does the donation comply with quality standards of the recipient country?                                                                                                                                                        | 1                                           | 4                                  | 25.0                                         |
| 4.4 Was the WHO Certification Scheme on the Quality of Pharmaceutical Products Moving in International Commerce used?                                                                                                                | 0                                           | 0                                  | 0.0                                          |
| 5.1 Was the donation free from returned/recycled medications, or free samples given to health professionals?                                                                                                                         | 20                                          | 21                                 | 95.2                                         |
| 6.1 Did the donated medicines have a remaining shelf life of at least 1 y on arrival at the recipient country?                                                                                                                       | 1                                           | 6                                  | 16.7                                         |
| 6.2 Do the donated quantities match the recipient countries' consumption needs before they are expired?                                                                                                                              | 2                                           | 5                                  | 40.0                                         |
| 7.1 Are the medicines labeled in a language easily understood by healthcare workers in the recipient country?                                                                                                                        | 1                                           | 3                                  | 33.3                                         |
| 7.2 Did the label of each container contain the International Non-proprietary Name (INN) or generic name of the medicine?                                                                                                            | 0                                           | 1                                  | 0.0                                          |
| 7.3 Did the label include batch number, dosage form and strength, name of manufacturer, country of manufacture, quantity in the container, storage conditions and expiry date?                                                       | 0                                           | 1                                  | 0.0                                          |
| 8.1 Were the donated medicines provided in appropriate pack sizes?                                                                                                                                                                   | 3                                           | 4                                  | 75.0                                         |
| 9.1 Was the donation packed in accordance with international shipping standards, accompanied by a detailed packing list and not mixed with other supplies (unless shipped as kits with predetermined contents)?                      | 3                                           | 6                                  | 50.0                                         |
| 10.1 Were medicines sent with prior consent of the recipient?                                                                                                                                                                        | 24                                          | 26                                 | 92.3                                         |
| 11.1 Was the declared value of the donation based on the wholesale price of the generic equivalent in the recipient country, or world-market price?                                                                                  | 4                                           | 4                                  | 100.0                                        |
| 12.1 Were the associated costs of transport, storage, port clearance, handling, disposal, etc. paid for by the donor (unless agreed upon with the recipient in advance)?                                                             | 27                                          | 27                                 | 100.0                                        |

prioritized and resources were in place to distribute the medicine. Once the donation was approved, production and shipment were scheduled. The donor arranged shipment to government medical stores, which were responsible for within-country distribution. CWW ensured that critical paperwork for customs clearance was available prior to the shipments being loaded onto a vessel. Delayed or missed medicine administration was evaluated.<sup>59</sup> In-country delays were the most common, due to lack of local resources or coordination by recipients. Shipping and customs issues occurred, including delays in arranging secondary overland

transport, difficulty in transporting to landlocked countries or insufficient budget in the recipient program for customs costs. To reduce production delays, recipients completed applications 1 y prior to the planned medicine administration.

#### Case example: poor compliance with medicine donation guidelines<sup>79</sup>

A Seattle-based NGO, Salaam Cultural Museum, distributed medicines in 2014 to Syrian refugees in Jordan on seven separate

**Table 6.** Percentage of medical device donations compliant with guideline items

| Guideline item                                                                                                                                                                                     | Number of donations that met guideline item | Number that reported on compliance | Percentage (%) compliant with guideline item |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------------------------------|----------------------------------------------|
| 1.1 Is the donation based on an expressed need from the recipient?                                                                                                                                 | 14                                          | 16                                 | 87.5                                         |
| 1.2 Was the donation based on agreement between the donor and recipient regarding the device(s) to be donated, shipping and customs arrangements, and whether donor or recipient covers any costs? | 5                                           | 8                                  | 62.5                                         |
| 2.1 Does the recipient country have the resources to install, operate, maintain and dispose of the equipment?                                                                                      | 8                                           | 10                                 | 80.0                                         |
| 2.2 Does the recipient have the available facilities, including physical space, stable electrical supply, water supply, heating or air-conditioning, to operate the equipment/device(s)?           | 5                                           | 7                                  | 71.4                                         |
| 2.3 Is the device(s) capable of being operated in a limited-resource setting?                                                                                                                      | 8                                           | 9                                  | 88.9                                         |
| 2.4 Does the device(s) have low energy consumption?                                                                                                                                                | 2                                           | 2                                  | 100.0                                        |
| 2.5 For device(s) requiring an energy source, has it been confirmed that one is available, or has an alternative power source been provided as appropriate?                                        | 4                                           | 6                                  | 66.7                                         |
| 2.6 If the device requires a power source, does the device have the correct plug adaptor for the recipient country?                                                                                | 1                                           | 4                                  | 25.0                                         |
| 3.1 Does the donation comply with national or organizational policy, or national guidelines, of the donor country?                                                                                 | 1                                           | 2                                  | 50.0                                         |
| 3.2 Does the donation comply with national or organizational policy, or national guidelines, of the recipient country?                                                                             | 1                                           | 1                                  | 100.0                                        |
| 4.1 Is the device(s) fully operational on arrival to the recipient country?                                                                                                                        | 7                                           | 11                                 | 63.6                                         |
| 4.2 Has sterilization/disinfection of the device(s) been considered and accounted for?                                                                                                             | 1                                           | 1                                  | 100.0                                        |
| 4.3 For refurbished device(s), were they restored to the manufacturer's original specifications?                                                                                                   | 2                                           | 2                                  | 100.0                                        |
| 4.4 Is the device(s) free from environmentally hazardous substances?                                                                                                                               | 0                                           | 1                                  | 0.0                                          |
| 4.5 Does the recipient have the resources to appropriately dispose of waste from the device(s)?                                                                                                    | 0                                           | 0                                  | 0.0                                          |
| 5.1 Is the device affordable to transport to the recipient?                                                                                                                                        | 5                                           | 5                                  | 100.0                                        |
| 5.2 Is it affordable to install?                                                                                                                                                                   | 6                                           | 6                                  | 100.0                                        |
| 5.3 Are transport and customs costs covered by the donor?                                                                                                                                          | 9                                           | 9                                  | 100.0                                        |
| 5.4 Is it affordable to maintain and service?                                                                                                                                                      | 0                                           | 1                                  | 0.0                                          |
| 5.5 Are staffing costs affordable?                                                                                                                                                                 | 3                                           | 3                                  | 100.0                                        |
| 5.6 Is it affordable to dispose of safely?                                                                                                                                                         | 0                                           | 0                                  | 0.0                                          |
| 6.1 Does the recipient country have personnel trained in operating donated equipment/device(s)?                                                                                                    | 7                                           | 10                                 | 70.0                                         |
| 6.2 Is there appropriate training available to personnel for use and/or maintenance of the device(s)?                                                                                              | 7                                           | 11                                 | 63.6                                         |
| 7.1 Are legends or labeling on the device(s) such as on instrument controls, in a language common in the recipient country?                                                                        | 0                                           | 1                                  | 0.0                                          |
| 7.2 Are user manuals, service or maintenance manuals, disposal instructions and software available as required in a language commonly used in the recipient country?                               | 1                                           | 2                                  | 50.0                                         |
| 8.1 Has the donor completed a checklist and provided it for the recipient to ensure that all components, accessories and supplies for initial operation are included?                              | 0                                           | 1                                  | 0.0                                          |
| 8.2 Are installation requirements specified and detailed installation instructions made available by the donor?                                                                                    | 2                                           | 2                                  | 100.0                                        |
| 8.3 Are all essential accessories and supplies available on arrival to the recipient country?                                                                                                      | 3                                           | 7                                  | 42.9                                         |
| 8.4 Does the donation include any auxiliary equipment required, e.g. X-ray film or medical gases?                                                                                                  | 4                                           | 6                                  | 66.7                                         |

Continued

**Table 6.** *Continued*

| Guideline item                                                                                                                                                                                          | Number of donations that met guideline item | Number that reported on compliance | Percentage (%) compliant with guideline item |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------------------------------|----------------------------------------------|
| 8.5 Is auxiliary equipment included with the donation sufficient to enable reasonable use of the device(s) for the required time span (e.g. minimum of 6 months from arrival in the recipient country)? | 5                                           | 7                                  | 71.4                                         |
| 8.6 If 'no' to above, is it confirmed that auxiliary equipment is available locally and that the recipient has the means to acquire them?                                                               | 2                                           | 5                                  | 40.0                                         |
| 9.1 Does the device have a minimum of 6 months shelf life from arrival in the recipient country?                                                                                                        | 3                                           | 6                                  | 50.0                                         |
| 9.2 Is maintenance for the device(s) required?                                                                                                                                                          | 5                                           | 5                                  | 100.0                                        |
| 9.3 Is manufacturer sales support, such as repair and maintenance assistance, available for a minimum of 2 y?                                                                                           | 1                                           | 2                                  | 50.0                                         |
| 9.4 Are maintenance materials provided or available for a minimum of 1 y of operation?                                                                                                                  | 3                                           | 4                                  | 75.0                                         |
| 10.1 Is the donation distributed through existing distribution channels?                                                                                                                                | 6                                           | 7                                  | 85.7                                         |
| 10.2 Was the device(s) safely and appropriately packaged prior to transport as per manufacturer's specifications?                                                                                       | 1                                           | 2                                  | 50.0                                         |
| 10.3 Was the device(s) decontaminated prior to shipping if required?                                                                                                                                    | 1                                           | 1                                  | 100.0                                        |
| 10.4 Do shipping documents list everything inside the shipment and specify that the shipment is a donation?                                                                                             | 0                                           | 0                                  | 0.0                                          |
| 10.5 Is shipping documentation provided in a language common in the recipient country?                                                                                                                  | 0                                           | 0                                  | 0.0                                          |
| 10.6 Has any special documentation required for customs clearance been provided by the recipient?                                                                                                       | 2                                           | 3                                  | 66.7                                         |
| 10.7 Did the donor cover any costs for the release of donations from customs or any taxes?                                                                                                              | 2                                           | 3                                  | 66.7                                         |
| 10.8 Has provision been made for the cost of transport within the recipient country, either by the recipient or by the donor?                                                                           | 4                                           | 4                                  | 100.0                                        |
| 10.9 On arrival, was the donation inspected to confirm contents are intact and undamaged?                                                                                                               | 0                                           | 0                                  | 0.0                                          |
| 10.10 If the device(s) had cold chain requirements, were these followed?                                                                                                                                | 0                                           | 0                                  | 0.0                                          |

occasions. Therapeutic indications included chronic diseases, of which many were not on the WHO essential medicines list. While some medicines were within 6 months of expiry and obtained legally via medicine recycling collaborations, others were leftover prescribed medicines from the general public, the distribution of which is illegal within the USA. A health professional donated medicines that had been discarded by a US hospital. These medicines had been disposed of due to concerns about the quality of the products. Donated medicines were distributed without appropriate packaging or labeling, some in a Ziploc bag labeled only with the medicine name and dose. Medicines were distributed by health professionals who travel independently to the country. No information is available about what happened to the medicines following arrival in the recipient country.

#### **Case example: good compliance with medical device donation guidelines<sup>19</sup>**

In 2012, researchers donated diagnostic devices to Takaya Health Centre in the Democratic Republic of Congo (DRC). The

donation was chosen based on consultation with physicians who had experience of working in the area and taking into consideration available resources. Devices were low-cost, durable and battery- or solar-powered. Rechargeable batteries and a solar-powered recharging system were included. To minimize importation challenges into the DRC, the donation was transported as luggage by healthcare workers visiting the region. The durability and functionality of the devices were evaluated quarterly following donation. A small portion of the devices was underutilized due to a lack of familiarity or training. Auxiliary devices were sufficient for approximately 6 months. Supplies that were depleted during the year following donation were mostly replaced by the recipient, with the exception of glucometer test strips that could not be obtained locally.

#### **Case example: poor compliance with medical device donation guidelines<sup>26,69</sup>**

Two reports discussed the medical equipment available in health facilities in Uganda, in 2013<sup>69</sup> and 2014,<sup>26</sup> respectively. Many of

**Table 7.** Common problems identified with medicine and medical device donations

| Guideline item                       | Identified problems                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Selection of medicines or devices    | <ul style="list-style-type: none"> <li>• Poor communication between donor and recipient</li> <li>• Donated amounts exceed recipient's needs, or was not needed</li> <li>• Medicines were not approved for use or were not commonly used in the recipient country</li> <li>• Medicines were not on WHO or country Essential Medicines List</li> <li>• Donations were not appropriate for a resource-limited setting</li> </ul>                    |
| Quality assurance and shelf life     | <ul style="list-style-type: none"> <li>• Devices did not use an appropriate power voltage</li> <li>• Expired or short shelf life</li> <li>• Unknown source, therefore unclear if counterfeit</li> <li>• Devices were not functional</li> <li>• Devices were donated without all required parts or consumables</li> <li>• Spare parts or consumables not available locally</li> </ul>                                                             |
| Presentation, packaging and labeling | <ul style="list-style-type: none"> <li>• No instruction manuals or manuals in inappropriate language</li> <li>• Labeling in a language not commonly used in the recipient country</li> <li>• Medicines not properly packaged</li> <li>• Mixtures of medical supplies sent that required sorting</li> </ul>                                                                                                                                       |
| Information and management           | <ul style="list-style-type: none"> <li>• Costs of transportation within recipient country not covered by donors</li> <li>• Customs delays due to incomplete paperwork</li> <li>• Recipients required to arrange customs clearance, cover storage or product disposal costs</li> <li>• Training not provided for the use or maintenance of devices</li> <li>• Negative environmental impact when donations disposed of inappropriately</li> </ul> |

the devices were donated, primarily by NGOs or other donors such as church groups. Recipients reported that donors appeared to 'dump' healthcare equipment,<sup>69</sup> donations appeared to be made to meet corporate responsibility targets,<sup>26</sup> and were often problematic. Devices were donated that were not functional or broke soon after arrival and could not be repaired due to a lack of training or locally available spare parts.<sup>69</sup> For example, one donated anesthesia machine was used once before it stopped working, and 13 of 20 incubators in one hospital were non-functional. Equipment was also often donated without all required parts, for example an infant warmer sent without a patient probe, which was therefore unsafe to use.<sup>26</sup> Donations often required a different power voltage to that used in Uganda. Ugandan Ministry of Health policy states that donors should ensure that electrical needs can be met, but this was not enforced.<sup>26</sup> Healthcare workers often did not receive training or instructions on how to use devices,<sup>26</sup> or instructions were provided in languages not commonly spoken in Uganda.<sup>69</sup> Lack of communication was an issue, and few donor organizations conducted needs assessments prior to donations (IMEC, Project C.U. R.E. and Samaritan's Purse).<sup>69</sup>

## Discussion

We found that the majority of donations were inadequately reported and at times did not comply with WHO guidelines.<sup>2,8,9</sup> Despite updated guidelines, we found that there is still poor compliance across all types of donations, unchanged from the results of a similar review of medicine donations conducted almost a decade ago.<sup>4</sup> Although our findings suggest there has

been little improvement in compliance, it is important to note that reporting of donations remains poor, which hinders the assessment of compliance. An identified barrier to guideline compliance was poor communication among stakeholders, which results in unsuitable or excessive donations. Donors often have limited involvement once the donation arrives in the recipient country, and the recipient bears the responsibility and costs for sorting, distributing and disposing of donations, creating financial and logistical burdens.

Following disaster events, there were often limited control mechanisms for the acceptance and distribution of medicines, and damage to existing distribution networks and infrastructure. Donations of medicines made following the 2010 Haiti earthquake were reported to have better compliance with guidelines than the response to previous disaster events.<sup>37</sup> This may be attributed to PROMESS, which was already established at the time of the earthquake.

Donations reported in peer-reviewed publications tended to provide more information concerning guideline compliance. These reports more commonly evaluated long-term medicine donation programs by pharmaceutical companies, and tended to reflect better guideline compliance. Donations for the management of NTDs were more likely to be on the WHO essential medicines list.<sup>32</sup> Long-term donation programs were characterized by more communication among stakeholders, application processes that prioritized endemic areas and involvement of experienced NGOs or multilateral agencies. They also incorporated community involvement, which makes programs more cost-effective and sustainable, particularly if multiple programs are combined.<sup>100</sup> Combining programs does, however, create a higher burden for community medicine distributors, who often receive little

compensation for their time. Moreover, withdrawal of external funding, lack of resources, political will, or capacity to distribute donations or implement mass drug administration programs in recipient countries, were challenges in long-term programs.

Donations can be made more effective by conducting needs assessments that facilitate communication among donors, recipients and local stakeholders, and using existing distribution networks such as community distribution networks or national health systems. Additionally, donors can engage qualified logistics personnel (e.g. pharmacists and logisticians), experienced NGOs or multilateral agencies, or utilize structured international control efforts with multiple donors such as horizontal donation programs, in which multiple programs utilize the same community workers for distribution. Ensuring local availability of spare parts and consumables, appropriate resources for operation and training for healthcare workers in the use and maintenance of devices is essential prior to the donation of medical devices. The development of checklists for both donors and recipients to evaluate compliance against WHO guideline items may help improve donations. Financial donations would allow recipients to purchase medical supplies that suit their needs, while stimulating local markets. Countries should have the capacity to reject donations that do not meet their needs and donors should be required to bear the costs of disposing of inappropriate donations. Efforts should also be focused on reducing bottlenecks in the supply chain, such as customs clearance, and the sorting and distribution of donations.

We acknowledge that currently there are other efforts that aim to improve medical Donations, such as the Partnership for Quality Medical donations (PQMD) and the Access to Medicines Index, although these were not the focus of this study.

This study has several limitations. Information sources were limited to publicly available media reports, company or NGO documents and journal articles in English. Many of these sources were written by affiliates of donors, and therefore may be biased towards the donor, whereas lay press reports may focus on donations with which problems occur. None of the reports for medicine donations provided sufficient information to assess compliance with all items in the WHO guidelines for either medicine or medical device donations. Percentages reported in the results must be interpreted with caution due to limited reporting on the details of each donation. More structured, transparent and in-depth reporting of donations, particularly following disaster events, would be beneficial for determining compliance with guidelines.

## Conclusion

The donation of medicines and medical devices can have a positive impact on providing or improving access to healthcare in low and middle income countries, but can cause a large burden to recipients to sort and store items, and dispose of inappropriate donations. Our findings suggest that improved compliance with WHO guidelines for medicine and device donations is urgently needed. The existing guidelines, if fully implemented, could achieve a positive health impact and limit the burden on already disadvantaged healthcare systems. Communication with recipients prior to making donations is essential to ensure that recipient needs are met, and to reduce wastage.

Partnerships with experienced NGOs or agencies and use of existing distribution networks would also make donations more effective.

## Supplementary data

Supplementary data are available at *International Health* online (<http://inthehealth.oxfordjournals.org/>).

**Authors' contributions:** SM developed the protocol, wrote the search strategy and undertook the literature search, conducted title and abstract and full text screening for final inclusion, collected and analyzed data, and drafted the manuscript. AF, LP and JW contributed to development of the protocol, conducted full text screening for final inclusion, extracted data and provided critical revision of drafts of the manuscript. LB devised the study, contributed to development of the protocol and analysis and full text screening for final inclusion, and provided critical revision of drafts of the manuscript. SM and LB are guarantors of the paper.

**Acknowledgements:** We thank Lisa Hedman and Suzanne Hill, the World Health Organization, and Quinn Grundy and Barbara Mintzes, the University of Sydney, for their comments on the study.

**Funding:** This work was supported by the World Health Organization.

**Competing interests:** None declared.

**Ethical approval:** Not required.

## References

- 1 Kamba PF, Ireeta ME, Balikuna S, et al. Threats posed by stockpiles of expired pharmaceuticals in low- and middle-income countries: a Ugandan perspective. *Bull World Health Organ.* 2017;95(8):594–8.
- 2 World Health Organization. Guidelines for Medicine Donations. Geneva, Switzerland, 2011.
- 3 Guilbaud A. Generous corporations? A Maussian analysis of international drug donations. *J Int Pol Theory.* 2018;14(2):203–22.
- 4 Bero L, Carson B, Moller H, et al. To give is better than to receive: compliance with WHO guidelines for drug donations during 2000–2008. *Bull World Health Organ.* 2010;88(12):922–9.
- 5 Berckmans P, Dawans V, Schmets G, et al. Inappropriate drug-donation practices in Bosnia and Herzegovina, 1992 to 1996. *N Engl J Med.* 1997;337(25):1842–5.
- 6 Pinheiro CP. Drug donations: what lies beneath. *Bull World Health Organ.* 2008;86(8):577–656.
- 7 Green AR. Drug donations are great, but should big pharma be setting the agenda? *The Guardian*, 2013.
- 8 World Health Organization. Medical device donations: considerations for solicitation and provision. Geneva, Switzerland, 2011.
- 9 World Health Organization. Guidelines for Health Care Equipment Donations. Geneva, Switzerland, 2000.
- 10 Howitt P, Darzi A, Yang GZ, et al. Technologies for global health. *Lancet.* 2012;380(9840):507–35.



- 11 Harris PA, Taylor R, Thielke R, et al. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform.* 2009;42(2):377–81.
- 12 China donates medical equipment to SA hospital. *African News Agency*, 25 April 2017.
- 13 Tanzania/Merck To Intensify Support in the Fight Against Schistosomiasis in Tanzania. *African Press Organisation Database of Press Releases Related to Africa*, 2012.
- 14 State Receives Record Drug Donation to Fight Worm Disease. *AllAfrica*, 25 May 2016
- 15 American Medical Resources Foundation. AMRF Equipment Donations Evaluated. *AMRF News*, Spring 2013. [https://www.amrf.com/uploads/1/1/7/2/117227506/2013\\_spring.pdf](https://www.amrf.com/uploads/1/1/7/2/117227506/2013_spring.pdf) [accessed 15 February 2018].
- 16 Arie S. Medical supplies are trapped in Haitian ports as NGOs struggle with paperwork and delays. *BMJ.* 2010;341:c3820.
- 17 Arellano Maric MP, Roldan Toledo R, Huttman SE, et al. Intermittent noninvasive ventilation at San Jose Hospital in Chile: report of a German donation. *Pneumologie.* 2015;69(3):144–6.
- 18 Bayer Extends Support to Fight Chagas Disease. *Bayer*, 2011.
- 19 Bauserman M, Hailey C, Gado J, et al. Determining the utility and durability of medical equipment donated to a rural clinic in a low-income country. *Int Health.* 2015;7(4):262–5.
- 20 Berkrot B. Biogen, Sobi pledge hemophilia drug donation in developing world. *Reuters*, 2018.
- 21 Binagwaho A, Ngabo F, Wagner CM, et al. Integration of comprehensive women's health programmes into health systems: cervical cancer prevention, care and control in Rwanda. *Bull World Health Organ.* 2013;91(9):697–703.
- 22 Boseley S. GSK to donate a billion tablets a year for neglected diseases. *The Guardian*, 2010.
- 23 Brack J. Needed Donated Medicines Arrive in Nepal Project Hope, 18 May 2015. <http://www.projecthope.org/news-blogs/in-the-field-blog/2015/needed-donated-medicines.html> [accessed 14 February 2018].
- 24 Bradley B, Yoon C, Zahedi S, et al. A study of medical equipment donations: recipient experiences. *The 39th Conference of the Canadian Medical and Biological Engineering*, 2016.
- 25 Case Study: Collaboration Leprosy Donation Program, Novartis International AG. Guiding principles on access to healthcare. <http://gpah.bsr.org/en/case-studies/view/leprosy-donation-program>. [accessed 12 February 2018].
- 26 Burpee J. Why Uganda should regulate medical equipment. *Daily Monitor*, 2014 [cited 2018 February 20]. <http://ezproxy.library.usyd.edu.au/login?url=https://search-proquest-com.ezproxy1.library.usyd.edu.au/docview/1619392187?accountid=14757>. [accessed 20 February 2018].
- 27 Burns M. RX for humanitarian relief: U.S. drug firms donate \$6 billion yearly overseas. *Pacific Standard*, 24 April 2010.
- 28 Bush S, Hopkins AD. Public-private partnerships in neglected tropical disease control: the role of nongovernmental organisations. *Acta Trop.* 2011;120(Suppl 1):S169–72.
- 29 The Jack Brewer Foundation and Immune Therapeutics Inc. Announce Medical Equipment Donation Program for the Prevention of Cervical Cancer in Africa to be Unveiled Today at the United Nations. *Cancer Weekly; NewsRX LLC*, 2015: 176.
- 30 Brazil makes drug donation to subregion. *Caribbean Media Corporation news agency. BBC Monitoring Americas*, 19 October 2012.
- 31 Claycomb J. Issues in emergency pharmacy. *Drug Topics*, 2013.
- 32 Cohen JP, Silva L, Cohen A, et al. Progress report on neglected tropical disease drug donation programs. *Clin Ther.* 2016;38(5):1193–204.
- 33 Compton B. Let's make donations more effective: don't waste these important efforts. *Health Prog.* 2012;93(2):84–6.
- 34 Cooper L. Urgently Needed Hemophilia Treatment Drugs Delivered to Puerto Rico Pediatric Hospital. *Direct Relief*, 28 September 2017.
- 35 Cumming-Bruce N. WHO takes lead on health as UN tackles crises. *Bull World Health Organ.* 2009;87(4):250–1.
- 36 Crump A, Morel CM, Omura S. The onchocerciasis chronicle: from the beginning to the end? *Trends Parasitol.* 2012;28(7):280–8.
- 37 de Ville de Goyet C, Sarmiento JP, Grünewald F. Health response to the earthquake in Haiti January 2010. Lessons to be learned for the next massive sudden-onset disaster. *Pan American Health Organization*, 2011.
- 38 Direct Relief Responding to Dengue Fever Outbreak in Bolivia. *Direct Relief*. <https://www.directrelief.org/2009/03/direct-relief-responding-dengue-fever-outbreak-bolivia/> [accessed 15 February 2018].
- 39 Dzwonczyk R, Riha C. Medical equipment donations in Haiti: flaws in the donation process. *Rev Panam Salud Publica.* 2012;31(4):345–8.
- 40 Eisai to provide medicine to help World Health Organization (WHO) combat Lymphatic Filariasis epidemic. *Eisai Co., Ltd.* <https://www.eisai.com/news/news201066.html>. [accessed 12 February 2018].
- 41 Eisai Begins Free Supply of DEC Tablets to Eliminate Lymphatic Filariasis -First Shipment Sent from Eisai's Vizag Plant, India. *Eisai Co., Ltd.* <https://www.eisai.com/sustainability/atm/medicines/005.html>. [accessed 12 February 2018].
- 42 Creating Leaflet for DEC Tablets in Local Languages for Endemic Countries. *Eisai Co., Ltd.* <https://www.eisai.com/sustainability/atm/medicines/013.html>. [accessed 12 February 2018].
- 43 DEC Project Managers' Efforts to Support Lymphatic Filariasis Elimination Activities in Indonesia *Eisai Co., Ltd.* <https://www.eisai.com/sustainability/atm/medicines/010.html>. [accessed 12 February 2018].
- 44 Escandor JM. US-based NGO gives CamSur php 172-M medical equipment. *The Philippines News Agency (PNA)*, 5 September 2014.
- 45 Finch LC, Kim RY, Ttendo S, et al. Evaluation of a large-scale donation of Lifebox pulse oximeters to non-physician anaesthetists in Uganda. *Anaesthesia.* 2014;69(5):445–51.
- 46 Friends of Disabled Adults and Children, Too! Collecting Supplies for Shipment to Haiti. *NewsRX LLC*, 2010: 3983.
- 47 Global Links responds to cholera outbreak in Haiti. *Critically Needed Materials Heading Out Thursday in Response to Urgent Requests by Pan American Health Organization. Global Links, Pittsburgh, Pennsylvania, USA*, 2010.
- 48 Gustavsen KM, Bradley MH, Wright AL. GlaxoSmithKline and Merck: private-sector collaboration for the elimination of lymphatic filariasis. *Ann Trop Med Parasitol.* 2009;103(Suppl 1):S11–15.
- 49 Hammerli S. Children's Hospital in Cuba Receives 2nd Shipment of Medicines & Supplies. <http://www.hearttoheart.org/children-hospital-in-havana-cuba-gets-2nd-shipment-of-medicines-supplies/> [accessed 20 March 2018].
- 50 World Vision, HPIC airlifts \$4 million cholera medications to Zimbabwe. *Health Partners International of Canada.* <https://reliefweb.int/report/zimbabwe/world-vision-hpic-airlifts-4-million-cholera-medications-zimbabwe> [accessed 5 March 2018].



- 51 Hoang. Vietnamese customs explains disposal of cancer drug. Vietnam News, 2017.
- 52 Hopkins A. Beyond providing drugs: the Mectizan(R) donation stimulates new strategies in service delivery and in strengthening health systems. *Curr Pharm Biotechnol*. 2012;13(6):1110-9.
- 53 Hower K, Garcia A. Global Links Takes on Coordination of Local Haiti Response Effort Unprecedented Collaboration Between Global Links, UPMC, Hopital Albert Schweitzer, Speeding Medical Response. <https://www.globallinks.org/stay-informed/media-press-releases> [accessed 15 February 2018].
- 54 International Health Partners. Thank You From Egypt. <http://www.ihpuk.org/news/4587288551/Thank-You-From-Egypt/11094231> [accessed 14 February 2018].
- 55 UN Migration Agency Supports Yemen's Struggling Health Care System [Internet]. International Organization for Migration. <http://www.iom.int/news/un-migration-agency-supports-yemens-struggling-health-care-system> [accessed 5 March 2018].
- 56 Janssen, the Pharmaceutical Companies of Johnson & Johnson, Announces First-of-its-Kind Drug Donation Program for HIV Treatment-Experienced Children. PR Newswire, 2013.
- 57 Jobe K. Disaster relief in post-earthquake Haiti: unintended consequences of humanitarian volunteerism. *Travel Med Infect Dis*. 2011;9(1):1-5.
- 58 Katabaazi Nakyenzi J, Kitutu FE, Oria H, et al. Expiry of medicines in supply outlets in Uganda. *Bull World Health Organ*. 2010;88(2):154-8.
- 59 Koporc KM, Strunz E, Holloway C, et al. Assessing 'first mile' supply chain factors affecting timeliness of school-based deworming interventions: supply and logistics performance indicators. *PLoS Negl Trop Dis*. 2015;9(12):e0004115.
- 60 Ladner J, Besson MH, Rodrigues M, et al. Prevention of mother-to-child HIV transmission in resource-limited settings: assessment of 99 Viramune Donation Programmes in 34 countries, 2000-2011. *BMC Public Health*. 2013;13:470.
- 61 Lauffenburger JC, Jonkman LJ, Lange CE, et al. A public-health approach to site-specific formulary management: addressing deficient drug supplies in Malawi. *Int J Pharm Pract*. 2011;19(3):201-5.
- 62 Lyatuu J. Coca-cola, Medshare give Kamuli Hospital Shs 1.4 billion equipment. The Observer Kampala, 3 November 2016.
- 63 Lynch C. Haiti's humanitarian aid disaster. *Foreign Policy*, 2010.
- 64 Mackenzie CD, Homeida MM, Hopkins AD, et al. Elimination of onchocerciasis from Africa: Possible? *Trends Parasitol*. 2012;28(1):16-21.
- 65 Investigators at Johnson & Johnson Discuss Findings in Tropical Medicine and Public Health (Assessing 'First Mile' Supply Chain Factors Affecting Timeliness of School-Based Deworming Interventions: Supply and Logistics Performance Indicator. *Malaria weekly*; NewsRX LLC, 2016: 38.
- 66 Manne JM, Snively CS, Ramsey JM, et al. Barriers to treatment access for chagas Disease in Mexico. *PLoS Negl Trop Dis*. 2013;7(10):e2488.
- 67 Mectizan Donation Program. Guide for Donations of Mectizan® to Accelerate the Elimination of Lymphatic Filariasis in Countries where Onchocerciasis is not co-endemic. Georgia, USA, 2017.
- 68 Fiji: Health Sector Receives Timely Donation from Turkish Government. Mena Report. Al Bawaba (Middle East) Ltd., 2014.
- 69 Miesen M. The Inadequacy of Donating Medical Devices to Africa. The Atlantic, 2013.
- 70 Morain T. Nepal Earthquake Response: Update 5/5 Direct Relief. <https://www.directrelief.org/2015/05/nepal-earthquake-response-update-55/> [accessed 5 March 2018].
- 71 Morain T. Direct Relief Airlifts 79,365 lbs of Emergency Medical Aid to Puerto Rico. <https://www.directrelief.org/2017/12/airlift-emergency-medical-aid-puerto-rico/> [accessed 15 February 2018].
- 72 Jacob M. Medical equipment donation to benefit Nyerere Hospital. AllAfrica, 7 July 2015.
- 73 Novartis and The Max Foundation to provide cancer access programme in lower-income countries. *Pharmaceutical Technology*. <https://www.pharmaceutical-technology.com/news/newsnovartis-the-max-foundation-to-provide-cancer-access-program-in-lower-income-countries-5934407/> [accessed 15 January 2018].
- 74 Novartis Delivers 250,000,000th Coartem® Treatment And Becomes First Healthcare Company To Join United Against Malaria Partnership. Dow Jones International News, 2009.
- 75 Novartis and The Max Foundation transform pioneering cancer access program for people in lower-income countries. Dow Jones Institutional News, 22 September 2017.
- 76 Novartis extends commitment to help achieve final elimination of leprosy. *European Pharmaceutical Review*. <https://www.europeanpharmaceuticalreview.com/news/10950/novartis-extends-commitment-to-help-achieve-final-elimination-of-leprosy/> [accessed 15 January 2018].
- 77 30 Pallets of Essential Medicine for the Philippines on board Air Canada flight [press release]. Health Partners International of Canada, 2013.
- 78 Parsons C. \$1.74 Million Worth of Apotex Medicine Being Airlifted to Ecuador. [www.hpicanada.ca/2016/1-74-million-worth-apotex-medicine-airlifted-ecuador/](http://www.hpicanada.ca/2016/1-74-million-worth-apotex-medicine-airlifted-ecuador/) [accessed 5 March 2018].
- 79 Partnow J, Stuteville S. Drug recycling: crime or compassion? The Seattle Globalist, 2014.
- 80 Janssen provides free courses of anti-TB drug bedaquiline. *Pharmaceutical Journal*. <https://www.pharmaceutical-journal.com/news-and-analysis/news-in-brief/janssen-provides-free-courses-of-anti-tb-drug-bedaquiline/20069580.article> [accessed 12 February 2018].
- 81 Sanomedics International Holdings; Sanomedics Supports Haiti Relief with Significant Medical Equipment Donation. *Pharma Business Week*, 2010.
- 82 Novartis, DOH vow to hasten progress in leprosy control. The Philippine Star, 2014.
- 83 Robles F, Daniel T, Charles J. Customs stalling aid efforts in Haiti as foreign do-gooders try to send humanitarian supplies, they are encountering problems- for a variety of different reasons. <http://www.hrdf.org/nongovernmental-organizations-ngo/customs-stalling-aid-efforts-in-haiti/> [accessed 7 February 2018].
- 84 Ryley S. Haitian Hospitals Awash With Supplies, Struggle to Pay Staff (Part 2). The Huffington Post, 2010.
- 85 Salenga R, Robles Y, Loquias M, et al. Medicines management in the Philippine public sector during the response to Haiyan. *Western Pac Surveill Response J*. 2015;6(Suppl 1):82-5.
- 86 Humanitarian emergencies in Côte d'Ivoire and Libya. Sanofi Espoir Foundation. [http://fondation-sanofi-espoir.com/en/news\\_2011-04-27.php](http://fondation-sanofi-espoir.com/en/news_2011-04-27.php) [accessed 13 February 2018].
- 87 Humanitarian emergencies in Pakistan, Thailand and Turkey. Sanofi Espoir Foundation. [http://fondation-sanofi-espoir.com/en/news\\_2011-11-04.php](http://fondation-sanofi-espoir.com/en/news_2011-11-04.php) [accessed 13 February 2018].
- 88 Solidarity with the people of Haiti following the passage of cyclone Matthew. Sanofi Espoir Foundation. <http://fondation-sanofi-espoir.com/en/news-2016-10-20-solidarity-haiti-cyclone-matthew.php> [accessed 13 February 2018].

- 89 Samsky A. Scientific sovereignty: how international drug donation programs reshape health, disease, and the state. *Cult Anthropol.* 2012;27(2):310–32.
- 90 Samsky A. The drug swallows: Scientific sovereignty and pharmaceuticalization in two international drug donation programs. *Reimagining (Bio)Medicalization, Pharmaceuticals and Genetics: Old Critiques and New Engagements.* Taylor and Francis, 2015: 112–36.
- 91 Savioli L, Albonico M, Colley DG, et al. Building a global schistosomiasis alliance: An opportunity to join forces to fight inequality and rural poverty. *Infect Dis Poverty.* 2017;6(1):65.
- 92 Smith R. Responding to devastation in Puerto Rico. Lilly, 2017.
- 93 Sumner E, O'Connell C, MacAlpine B. Wheelchair donation in a low-resources setting: utilization, challenges and benefits of wheelchairs provided through a specialized seating programme in Haiti. *J Rehabil Med.* 2017;49(2):178–84.
- 94 Tekinturhan E, Audureau E, Tavalacci MP, et al. Improving access to care in low and middle-income countries: institutional factors related to enrollment and patient outcome in a cancer drug access program. *BMC Health Serv Res.* 2013;13:304.
- 95 Project HOPE and U.S. Government deliver medical assistance for Tajik hospitals. *Times of Central Asia*, 2009.
- 96 Tajikistan: Project HOPE delivers \$7.9 million of medical supplies to Tajik hospitals. US Department of State. <https://reliefweb.int/report/tajikistan/tajikistan-project-hope-delivers-79-million-medical-supplies-tajik-hospitals> [accessed 5 March 2018].
- 97 U.S. Embassy delivers \$35 million in donated medicine to Tajikistan. *Times of Central Asia*, 2011.
- 98 Wan EL, Xie L, Barrett M, et al. Global public health impact of recovered supplies from operating rooms: a critical analysis with national implications. *World J Surg.* 2015;39(1):29–35.
- 99 Zhang Y, Zhang Y, Guyatt GH. Why West Africa rejected donation of Chinese medicine for treating Ebola recommended by Chinese government? *Complement Ther Med.* 2015;23(3):505–7.
- 100 Liese B, Rosenberg M, Schratz A. Programmes, partnerships, and governance for elimination and control of neglected tropical diseases. *Lancet.* 2010;375(9708):67–76.