Health system determinants of access to essential medicines for children with cancer in Ghana

Rhonda Boateng,1 Lorna Renner,2 Kadia Petricca,1,3 Sumit Gupta,1,3,4 Avram Denburg © 1,3,4

ABSTRACT

Background Evidence of the context-specific challenges related to childhood cancer drug (CCD) access is vital to improving outcomes for children with cancer in low- and middle-income countries, such as Ghana. We sought to determine the availability and cost of essential CCD in Ghana and identify the underlying determinants of access.

Methods Our study integrated quantitative data on drug prices and availability with qualitative insights into health system and sociopolitical determinants of CCD access in Ghana. We analysed retrospective monthly price and stock data for 41 cancer and supportive care drugs on the WHO Essential Medicines List (EML) from private retail and public institutional pharmacies. Non-parametric analyses evaluated relationships between drug price and availability, and impacts of drug class and formulation on availability and procurement efficiency. We assessed the determinants of drug access through thematic analysis of policy documents and semi-structured interviews (n=21) with key health system stakeholders.

Results Ghana lists only 47% of essential CCD on its National EML, revealing gaps in domestic formulary inclusion. Stock-outs occurred for 68% of essential CCD, with a 70-day median stock-out duration; 32% had median price ratios above internationally-accepted efficiency thresholds. Drugs procured inefficiently were more susceptible to stock-outs (p=0.0003). Principal determinants of drug access included: (1) lack of sociopolitical priority afforded childhood cancer and (2) the impact of policy and regulatory environments on drug affordability, availability and quality. Establishment of a population-based cancer registry, a nationally-coordinated procurement strategy for CCD, public financing for childhood cancer care and policies to control drug costs emerged as priority interventions to improve drug access in Ghana.

Conclusion Our study provides context-specific evidence to enable responsive policy development for efficient drug procurement and supply management in Ghana and establishes a rigorous approach to the analysis of childhood cancer drug access in similar health system settings.

Key questions

What is already known?
► The effective care of children with cancer requires equitable access to quality chemotherapeutic and supportive care medicines.
► Little rigorous data exists on the availability of, and determinants of access to, essential medicines to treat childhood cancer in low- and middle-income countries (LMICs), including Ghana.

What are the new findings?
► Access to essential medicines for children with cancer in Ghana is determined by the political and societal priority afforded childhood cancer.
► Policy legacies fostered by sustained system focus on communicable disease control and primary care strengthening have engendered neglect in the realm of non-communicable disease drug policy, including childhood cancer.
► Weak drug price controls, inefficient procurement models and lack of financial coverage of childhood cancer have significant impacts on the availability of, and access to, childhood cancer medicines in Ghana.

What do the new findings imply?
► Efforts to improve access to essential medicines for children with cancer in LMICs, including Ghana, hinge on a nuanced understanding of system-level impediments to access.
► Our study highlights the impacts of existing policy, regulatory and health service delivery approaches on childhood cancer drug availability, affordability and quality in Ghana, emphasizing the role of inherited political priorities and system siloes in perpetuating access barriers.

INTRODUCTION

The mounting threat that non-communicable diseases (NCDs) pose to health outcomes in low- and middle-income countries (LMICs) has galvanised global efforts to thwart premature mortality from NCDs, including cancer.1 Of the estimated 397 000 children with cancer worldwide,2 80% of cases reside in LMICs, with an expected 30% increase in diagnosed cases of childhood cancer by 2020.3 While 80% of children in high-income countries are cured, only 10% to 50% of children survive cancer in...
LMICs due to health system and resource constraints. The WHO Global Initiative for Childhood Cancer aims to achieve a global survival rate of 60% by 2030. Bridging the survival gap will require addressing system-level challenges through the development and implementation of evidence-based national childhood cancer strategies.

The effective care of children with cancer necessitates equitable access to quality chemotherapeutic and supportive care medicines. Elucidating context-specific determinants of drug access can inform national and institutional planning and facilitate childhood cancer drug (CCD) procurement. Such evidence can also empower stakeholders to address systemic issues including limited formularies, unsuitable product formulations and erratic drug prices.

In Ghana, limited access to essential medicines compromises treatment across a range of health conditions, including cancer. A recent assessment by the Ghana National Drugs Programme reported poor availability of palliative and anti-cancer drugs at Korle-Bu Teaching Hospital (KBTH) and Komfo-Anokye Teaching Hospital (KATH)—Ghana’s principal cancer treatment facilities, and only centres for paediatric oncology care. However, little rigorous data exists on the availability of, and determinants of access to, essential medicines to treat childhood cancer in Ghana. We sought to generate policy-relevant evidence on the state of and challenges related to access to essential CCD in Ghana.

METHODS

Study design

Our study mapped and analysed the determinants of CCD access in Ghana through in-depth, mixed-methods analysis of: (1) the availability and cost of essential CCD; and (2) the health system and sociopolitical determinants of drug access for children with cancer. We employed a convergent parallel mixed-methods case study design. The qualitative and quantitative strands of inquiry were analysed separately. Integration of the strands occurred at the level of interpretation and reporting through a contiguous narrative approach.

Patient and public involvement

Patients and members of the public were not involved in the design, conduct, reporting or dissemination of this research as it focussed on the perspectives of health system decision-makers and care providers, and the collection of institutional data on drug availability.

Data collection

We assessed alignment of the 2017 version of the Ghanaian National Essential Medicines List (NEML) with the WHO Essential Medicines List for Children (EMLc) to gauge priority-setting for childhood cancer drugs at a national level. Quantitative data consisted of monthly patient price and stock-out data for 41 essential cancer and supportive care drugs. Data on oncology drugs derived from Rock Chemist, a private retail pharmacy that supplies the vast majority of CCD to KBTH and KATH; data on supportive care drugs were obtained from the Child Health Unit (CHU) at KBTH. We defined stock-out a priori as the lack of medicine availability at the point of patient care. Our sources of drug data were selected to balance data completeness and relevance to real-world availability to patients: Rock Chemist for cytotoxics (direct to KBTH patients and direct to KATH paediatric oncology pharmacy) and KBTH CHU pharmacy for supportive care agents. Drug stock and price data were retrospectively collected for the period of 1st January 2018 to 31st March 2019. Different formulations of the same drug were assessed independently. Qualitative data consisted of in-person, semi-structured interviews with a stratified purposive sample of health system stakeholders, to generate a context-specific understanding of the Ghanaian health system and pharmaceutical value chain for CCD. Key informants were identified through purposive and snowball sampling techniques, including review of relevant policy and academic literature, scans of institutional websites and policy documents and recommendation by participants. Of those invited to participate in qualitative interviews, none declined, terminated the interview early or withdrew their data following interview completion. Twenty-one key stakeholders were interviewed between 1st October 2018 and 5th December 2018, representing policymakers and civil servants (n=8), health professionals (n=9), private pharmaceutical representatives (n=2) and members from civil society organisations (n=2). Our sample size was determined by the identification of thematic saturation through constant comparison with emergent themes. The interviews, ranging from 35 to 90 min, were conducted in English.

We also reviewed relevant policies to confirm, explain and expand findings from interviews. These included: Standard Treatment Guidelines 2017, Ghana’s National Medicines Policy (2017), Essential Medicines List (2017), 2018 New Operational Prices of Medicines on the National Health Insurance Scheme (NHIS) List (2018), National Strategy for Cancer Control in Ghana 2012 to 2016 (2011) and Guidelines for the Registration of Medicinal Products Classified for Fast-track Processing (2015). Qualitative insights deriving from policy documents in the results are referenced.

We employed the Pediatric Oncology System Integration Tool (POSIT) and the Management Sciences for Health’s (MSH) Managing Drug Supply (MDS-3) framework as heuristics for the development of the interview guide. POSIT is an expert-informed framework that identifies key health system components impacting the delivery of childhood...
Drug procurement efficiency, availability and costs

Forty-five relevant cytotoxic and supportive care drugs are listed on both the EMLc and NEML; we were able to obtain availability and price data for 41 formulations (30 distinct agents). Twenty-six different generic formulations of 21 CCD were accessible to KATH and KBTH. Seven out of 26 cytotoxic medicines (26.9%) had MPR > 2.5. The median and mean MPR for cytotoxic drugs were 1.89 and 2.69, respectively (range=0.35 to 9.1). Of a sample of 15 supportive care drugs, 12 had sufficient information to yield an MPR. Four supportive care medicines had MPR > 1.5. The median and mean MPR for supportive care medicines were 1.42 and 3.62, respectively (range=0.07 to 19.71). Overall, 11 of 38 drugs (29.0%) were subject to inefficient procurement (table 2).

Our data evince a significant positive correlation between cytotoxic drug price and MPR (r_s=0.56, p=0.004, 95% CI (0.24 to 0.88)). Moreover, our analysis demonstrates a positive relationship between MPR and number of stock-out days (r_s=0.56, p=0.0003, 95% CI (0.33 to 0.91)). There was no significant difference in stock-out days between cytotoxic drugs (median=72.5) and supportive care drugs (median=31) (p=0.25; 95% CI (~25 to 67)), suggesting that drugs procured inefficiently experienced more prolonged unavailability, regardless of class. While there was no significant difference in procurement efficiency among cytotoxic and supportive care drugs, 12 had sufficient information to yield an MPR. Four supportive care medicines had MPR >1.5. The median and mean MPR for supportive care medicines were 1.42 and 3.62, respectively (range=0.07 to 19.71). Overall, 11 of 38 drugs (29.0%) were subject to inefficient procurement (table 2).

Price fluctuation

No notable drug price fluctuations were experienced over the 15-month period. Overall, the price of two cytotoxic and one supportive care drug varied between January 2018 and March 2019: the prices of doxorubicin
Table 1  Alignment of WHO EMLc, Ghana NEML and NHIS

| Cytotoxic and supportive care medicines | WHO EMLc 2017 | NEML 2017 | NHIS |
|----------------------------------------|--------------|-----------|------|
| Asparaginase                           | X            |           |      |
| Bleomycin                              | X            |           |      |
| Carboplatin                            | X            | X         | NR   |
| Cisplatin                              | X            | X         | NR   |
| Cyclophosphamide                       | X            | X         | Injection 200 mg: NR Injection 500 mg: R Tablet 50 mg: NR |
| Cytarabine                             | X            |           |      |
| Dacarbazine                            | X            |           |      |
| Dactinomycin                           | X            |           |      |
| Daunorubicin                           | X            |           |      |
| Docetaxel                              | X            |           |      |
| Doxorubicin                            | X            | X         | NR   |
| Etoposide                              | X            | X         | NR   |
| Hydroxyureidamide (hydroxyurea)        | X            | X         | NR   |
| Ifosfamide                             | X            |           |      |
| Imatinib                               | X            |           |      |
| Irinotecan                             | X            |           |      |
| Mercaptopurine                         | X            |           |      |
| Methotrexate                           | X            | X         | R    |
| Paclitaxel                             | X            |           |      |
| Tioguanine                             | X            |           |      |
| Vinblastine                            | X            | X         | NR   |
| Vincristine                            | X            | X         | NR   |
| Acyclovir                              | X            | X         | R    |
| Allopurinol                            | X            | X         | R    |
| Amikacin                               | X            |           |      |
| Amitriptyline                          | X            | X         | R    |
| Amoxicillin                            | X            | X         | R    |
| Amoxicillin + clavulanic acid          | X            | X         | R    |
| Ampicillin                             | X            | X         | R    |
| Aprepitant                             | X            | X         | R    |
| Azithromycin                           | X            | X         | R    |
| Benzathine benzylpenicillin            | X            | X         | NR   |
| Benzylpenicillin                       | X            | X         | R    |
| Calcium folinate                       | X            |           |      |
| Cefalexin                              | X            |           |      |
| Cefazolin                              | X            |           |      |
| Cefotaxime                             | X            | X         | R    |
| Ceftazidime                            | X            |           |      |
| Ceftriaxone                            | X            | X         | R    |
| Chloramphenicol                        | X            | X         | R    |
| Ciprofloxacin                          | X            | X         | R    |
| Clindamycin                            | X            | X         | R    |
| Cloxacillin                            | X            | X         | R    |
| Dexamethasone                          | X            | X         | R    |

Continued
and cyclophosphamide tablets demonstrated one-time increases by 10 cedis (Ghanaian cedi) (14%) and 0.5 cedis (20%), respectively. To deplete stocks due to imminent expiry, the price of ceftriaxone (2 g) was reduced once from 75 to 60 cedis (20%).

**Determinants of childhood cancer drug access**

Despite governmental acknowledgement of childhood cancer on national policy agendas, as exemplified in Ghana’s *National Strategy for Cancer Care 2012–2016*,23 multiple systemic barriers at the national and institutional levels impede access to CCD. Two dominant themes emerged: (1) lack of political and societal priority for childhood cancer, due to competing health system priorities coupled with limited scientific and lay knowledge of the problem; and (2) the influence of existing policy and regulatory milieu on CCD affordability, availability and quality. Together, these themes reveal the role of policy legacies and the interplay of political, economic and societal factors shaping CCD access.

| Cytotoxic and supportive care medicines | WHO EMLc 2017 | NEML 2017 | NHIS |
|----------------------------------------|--------------|-----------|------|
| Diazepam                               | X            | X         | R    |
| Dimenhydrate (Gravol)                  |              |           |      |
| Docusate sodium                       | X            |           |      |
| Domperidone                            | X            |           |      |
| Doxycycline                            | X            | X         | R    |
| Erythromycin                           | X            | X         | R    |
| Filgrastim (granulocyte colony-stimulating factor) | X            |           |      |
| Fluconazole                            | X            | X         | R    |
| Fluoxetine                             | X            | X         | R    |
| Gabapentin                             | X            |           | R    |
| Gentamicin                             | X            | X         | R    |
| Granisetron                            | X            | X         | R    |
| Ibuprofen                              | X            | X         | R    |
| Imipenem + cilastatin                  | X            |           |      |
| Lactulose                              | X            | X         | R    |
| Meropenem                              | X            |           |      |
| Mesna                                  | X            |           |      |
| Metoclopramide                         | X            | X         | R    |
| Metronidazole                          | X            | X         | R    |
| Midazolam                              | X            | X         | R    |
| Morphine                               | X            | X         | R    |
| Nitrofurantoin                         | X            | X         | R    |
| Olanzapine                             | X            |           | R    |
| Ondansetron                            | X            | X         | R    |
| Paracetamol                            | X            | X         | R    |
| Phenobarbitone/phenobarbital           | X            | X         | R    |
| Phenoxympenicillin                     | X            | X         | R    |
| Phenytoin                              | X            | X         | R    |
| Prednisolone                           | X            | X         | R    |
| Procain benzylpenicillin               | X            |           |      |
| Senna                                  | X            | X         | NR   |
| Sulfamethoxazole + trimethoprim (co-trimoxazole) | X            |           |      |
| Trimethoprim                           | X            |           |      |
| Vancomycin                             | X            | X         | R    |

R: Drugs covered by NHIS and reimbursed by National Health Insurance Authority. 
NR: Drugs not covered by NHIS.

EMLc, Essential Medicines List for Children; NEML, National Essential Medicines List; NHIS, National Health Insurance Scheme.
Political and societal priority for childhood cancer

The political priority afforded to childhood cancer in policy development at the national and institutional levels emerged as a critical determinant of CCD access in Ghana. A majority of participants at all levels of the health system maintained that the absence of a dedicated, consistent focus on childhood cancer as a public health issue has hindered the establishment of national systems for data capture in order to forecast need, impact policy and galvanise momentum for increased health awareness among the public and health providers. Systemic challenges to improved access to CCD included: (1) competing allocative priorities for the health system; (2) inadequate public and health provider awareness of childhood cancer; and (3) weak data systems, resulting in a paucity of evidence for policymaking on childhood cancer.

Competing health priorities

Participants highlighted a range of considerations instrumental to the political prioritisation of health issues in Ghana, including disease burden, cost-effectiveness, return on investment, availability of international donor funds and degree of public awareness. Many noted that both limited data and policymakers’ perceptions of these criteria in relation to childhood cancer have constrained its inclusion on national health policy agendas:

They [government] don’t think the survival is good enough for them to invest in the management of childhood cancer. They think it is awfully expensive. So, there is no point in putting money into something with abysmal outcomes. (Healthcare provider)
| Cytotoxic and supportive care medicines | Quantity | Method of administration | Purchasing unit | Generic/brand | Wholesale supplier price (GHS) | Wholesale supplier price (US$)* | MSH median supplier price (US$) | Median price ratio |
|----------------------------------------|----------|--------------------------|----------------|--------------|-------------------------------|-------------------------------|---------------------------------|-----------------|
| Asparaginase 10 000 IU/ml              | Injection| Single dose vial          | Generic        | 350.00       | 68.63                         | 52.88‡                        |                                 | 1.30            |
| Bleomycin 15 IU                        | Injection| Vial                     | Generic        | 150.00       | 29.41                         | 12.15                         |                                 | 2.42            |
| Carboplatin 450 mg                     | Injection| Vial                     | Generic        | 350.00       | 68.63                         | 34.33                         |                                 | 2.00            |
| Carboplatin 150 mg                     | Injection| Vial                     | Generic        | 140.00       | 27.45                         | 14.89                         |                                 | 1.84            |
| Cisplatin 1 mg/mL                      | Injection| Vial                     | Generic        | 1.00         | 0.20                          | 0.11                          |                                 | 1.74            |
| Cyclophosphamide 500 mg                | Injection| Vial                     | Generic        | 15.00        | 2.94                          | 8.16                          |                                 | 0.36            |
| Cyclophosphamide 50 mg                 | Oral     | Five blisters of 10 tablets| Generic       | 3.00         | 0.59                          | 0.30‡                         |                                 | 1.94            |
| Cytarabine 100 mg                      | Injection| Vial                     | Generic        | 30.00        | 5.88                          | 3.11                          |                                 | 1.89            |
| Dacarbazine 200 mg                     | Injection| Vial                     | Generic        | 90.00        | 17.65                         | 6.81‡                         |                                 | 2.59            |
| Dactinomycin 500mcg                    | Injection| Vial                     | Generic        | 60.00        | 11.76                         | 8.70‡                         |                                 | 1.35            |
| Docetaxel 20 mg                        | Injection| Vial                     | Generic        | 240.00       | 47.06                         | 5.17                          |                                 | 9.10            |
| Docetaxel 80 mg                        | Injection| Vial                     | Generic        | 780.00       | 152.94                        | 17.51                         |                                 | 8.73            |
| Doxorubicin 50 mg                      | Injection| Vial                     | Generic        | 70.00        | 13.73                         | 7.26                          |                                 | 1.89            |
| Epirubicin 50 mg                       | Injection| Vial                     | Generic        | 250.00       | 49.02                         | 21.68‡                        |                                 | 2.26            |
| Etoposide 20 mg/mL                     | Injection| Vial                     | Generic        | 6.00         | 1.18                          | 0.39                          |                                 | 3.04            |
| Etoposide 500 mg                       | Oral     | Capsules                 | Generic        | 30.00        | 5.88                          | N/A†                          |                                 | --              |
| Fluorouracil 50 mg/mL                  | Injection| Ampoule                  | Generic        | 1.50         | 0.29                          | 0.20                          |                                 | 1.44            |
| Hydroxyurea 500 mg                     | Oral     | Capsules                 | Generic        | 2.00         | 0.39                          | 0.22‡                         |                                 | 1.80            |
| Ifosfamide 1 g                         | Injection| Vial                     | Generic        | 90.00        | 17.65                         | 10.78                         |                                 | 1.64            |
| Irinotecan 20 mg/mL                    | Injection| Vial                     | Generic        | 180.00       | 35.29                         | 5.78‡                         |                                 | 6.11            |
| Mercaptopurine 50 mg                   | Oral     | Tab                      | Generic        | 4.00         | 0.78                          | 2.24‡                         |                                 | 0.35            |
| Methotrexate 25 mg/mL                  | Injection| Vial                     | Generic        | 15.00        | 2.94                          | 2.63                          |                                 | 1.12            |
| Methotrexate 2.5 mg                    | Oral     | Tab                      | Generic        | 1.50         | 0.29                          | 0.16                          |                                 | 1.87            |
| Paclitaxel 100 mg/mL                   | Injection| Vial                     | Generic        | 210.00       | 41.18                         | 11.08‡                        |                                 | 3.71            |
| Vinblastine 10 mg/mL                   | Injection| Vial                     | Generic        | 75.00        | 14.71                         | 2.55                          |                                 | 5.76            |
| Vincristine 1 mg                       | Injection| Vial                     | Generic        | 15.00        | 2.94                          | 3.25                          |                                 | 0.90            |
| Ibuprofen 100 mg/5 mL                  | Oral     | 60 mL suspension         | Generic        | 0.06         | 0.01                          | 0.01                          |                                 | 2.18            |
| Paracetamol 120 mg/5 mL                | Oral     | 100 mL syrup             | Generic        | 0.03         | 0.01                          | 0.01                          |                                 | 1.13            |

Continued
| Cytotoxic and supportive care medicines | Quantity       | Method of administration | Purchasing unit | Generic/brand | Wholesale supplier price (GHS) | Wholesale supplier price (US$)* | MSH median supplier price (US$) | Median price ratio |
|-----------------------------------------|-----------------|--------------------------|-----------------|---------------|-------------------------------|---------------------------------|-------------------------------|------------------|
| Morphine                                | 10 mg/mL        | Injection                | Ampoule         | Generic       | 0.18                          | 0.04                            | 0.53                          | 0.07             |
|                                         | 10 mg/5 mL      | Oral                     | 200 mL syrup    | Generic       | N/A‡                          | --                              | N/A†                          | --               |
| Dexamethasone                           | 4 mg/mL         | Injection                | 2 mL            | Generic       | 0.40                          | 0.08                            | 0.10                          | 0.79             |
|                                         | 0.5 mg          | Oral                     | N/A‡            | Generic       | N/A‡                          | --                              | 0.01                          | --               |
| Ceftriaxone                             | 1g              | Injection                | N/A‡            | Generic       | 4.50                          | 0.88                            | 0.40                          | 2.22             |
|                                         | 1g              | Injection                | N/A‡            | Brand         | 40.00                         | 7.84                            | 0.40                          | 19.71            |
|                                         | 2g              | Injection                | N/A‡            | Brand         | 60.00                         | 11.76                           | N/A‡                          | --               |
| Ciprofloxacin                           | 2 mg/mL         | Injection                | 100 mL          | Generic       | 0.03                          | 0.00                            | 0.01                          | 0.49             |
|                                         | 250 mg/5 mL     | Oral                     | 100 mL suspension | Generic     | 7.80                          | 1.53                            | 0.13‡                         | 11.93            |
| Gentamicin                              | 40 mg/mL        | Injection                | 2 mL            | Generic       | 0.20                          | 0.04                            | 0.06                          | 0.64             |
| Co-trimoxazole                          | 240 mg/5 mL     | Oral                     | 100 mL suspension | Generic     | 0.04                          | 0.01                            | 0.01                          | 1.43             |
|                                         | 480 mg          | Oral                     | Tab             | Generic       | 0.09                          | 0.02                            | 0.01                          | 1.47             |
| Prednisolone                            | 5 mg            | Oral                     | Tab             | Generic       | 0.08                          | 0.02                            | 0.01                          | 1.41             |

*Exchange rate as at 27 March 2019 was 5.1 Ghanaian cedi to 1 US dollars.
†Information unavailable.
‡MSH buyer price used as MSH supplier price unavailable.
GHS, Ghanaian cedi; MSH, Management Sciences for Health; US$, US dollar.
Despite the upward trend in the incidence of NCDs in Ghana, several participants affirmed that Ghana’s health system priorities are largely focussed on and designed for communicable disease control, health promotion and primary care strengthening.24 The policy legacies produced by this health system milieu were seen to constrain opportunities for policy agenda-setting and development of health services geared toward the management of chronic diseases.

Inadequate awareness
Although cancer control policy focusses largely on awareness generation, participants described childhood cancer knowledge gaps among the public and health providers as a significant barrier to generating policy attention for improved drug access. Both health providers and civil servants drew attention to an ongoing need to broaden public and provider knowledge to encourage early hospital presentation and minimise misdiagnosis:

People may not know that this is cancer and they may treat for something else for some months even in a health facility before they come to the realisation that this is cancer and then they eventually come to us. So that is where awareness plays an important role even among health workers. (Healthcare provider)

As CCD are mostly accessed through KATH and KBTH, greater awareness could impact referral systems and thus warrant improved mechanisms to forecast and attend to prospective increases in drug need. One civil servant remarked that the efficiency of the referral system is another major determinant of timely CCD access, necessitating greater modes of communication across health institutions.

Weak data systems
The routine absence of data on childhood cancer from national reporting and health information systems was viewed by many participants as both a cause and a consequence of anaemic political priority. Participants cast the lack of rigorous, publicly collected childhood cancer incidence and outcomes data as a foundational constraint to drug access and evidence-informed policymaking. Such data was viewed as essential for determining burden of disease, quantifying CCD need, furnishing justification for NEML inclusion and incentivising both national and private procurement. To improve data collection on incidence, KATH and KBTH maintain hospital-based registries specific to childhood cancer through the support of a civil society organisation. Participants noted, however, that these efforts exist at the margins of health system priorities and stressed that the lack of nationally coordinated childhood cancer data impedes the establishment of effective interventions to improve drug access.

Influence of policy environments on cancer drug affordability, availability and quality
The influence of policies governing drug regulation and financing in Ghana emerged as principal determinant of CCD access. Inadequate policy and regulatory guidance has abetted persistent problems with CCD affordability, availability and quality.

Affordability
Many participants emphasised the cost of drugs as a demand-side factor impeding access to CCD. Children with cancer do not benefit from treatment coverage under the NHIS. Evidence also supports claims that paediatric formulations are typically more expensive than adult formulations.25 Drug purchases therefore constitute a substantial out of pocket (OOP) expense that most families cannot afford. Patients rely heavily on financial support from donors to provide CCD access. The paediatric oncology unit at KATH uses donor funds to stock vincristine, cyclophosphamide, methotrexate, cytarabine and doxorubicin, which are provided to patients free of charge. While KBTH does not stock CCD, donor funds are provided to caregivers to purchase medicines at local retail pharmacies.

Compounding these demand-side constraints, a number of supply-side determinants of affordability emerged. Participants related high drug costs to both the presence and absence of regulations, including high import duties and taxes, drug registration-related costs, minimal drug pricing controls and limited financing options. The persistent high costs associated with the importation of cytotoxic and supportive care agents were frequently ascribed to prevailing taxation policies, compounded by unfavourable exchange rates. Duties and tariffs routinely constitute 30% to 40% of the final price of imported medicines.25 In recognition of this burden, a participant affirmed that parliament approved a value added tax (VAT) exemption on imported drugs in November 2017, and reduced benchmark NHIS prices accordingly, with the expectation of a 30% retail drug price reduction. However, participants uniformly affirmed a lack of consequent price reductions at the retail level. For drugs to qualify for public reimbursement, retail prices offered by NHIS-credentialed pharmacies must reflect NHIS operational prices. As a consequence of this policy change, NHIS operational prices were abruptly incommensurate with the prices charged by retail outlets. Consequently, a range of drugs lost NHIS coverage, conferring additional OOP expenses on patients. The unanticipated maintenance of prices in the face of VAT exemption has thus had perverse ramifications for drug affordability. Participants expressed hope that if these unanticipated downstream policy effects are addressed, the VAT exemption policy has the potential to improve affordability of medicines.

Lack of price control measures in the pharmaceutical market were also cited as a key cost driver. Medicine prices in Ghana are among the highest in Africa: an estimated 50% to 200% of a drug’s retail price is attributed to retail mark-ups.25 In Ghana, CCD supply is heavily dependent on the private sector. The few outlets that stock oncology drugs have minimal competition and can dictate prices without government oversight or control.
Related to this, there was widespread recognition that the lack of financial incentives for industry to supply CCD, stemming from small aggregate markets and fractured procurement channels, has served to drive up and sustain high cancer drug prices. Participants from the government and pharmaceutical sector affirmed that supplying oncology drugs was perceived by many suppliers as not economically viable due to low demand.

To redress price-related challenges, the government has enacted policies to both augment incentives for cancer drug provision and strengthen central control of drug prices. Ghana’s Food and Drugs Authority (FDA) classifies oncology drugs under the orphan drug category.26 Orphan drugs benefit from a discounted registration fee and FDA decision within 3 months. Measures to control prices include the establishment of a National Medicine Price Committee (NMPC). The NMPC is mandated to manage the pricing system for pharmaceuticals in Ghana, instituting a national drug price reference index—including publication of maximum sales and reimbursement prices for all essential, patented and expensive medicines—and provisions to protect stakeholders from exposure to price fluctuations.27

Availability

A range of participants reported recurrent issues with drug availability, attributed to problems at various points along the pharmaceutical value chain. With respect to the quantitative stock-out trends observed (figure 2), no one explanator accounted entirely for this variability over time; rather, participants cited a range of factors including quantification issues, delays in bulk consignments and unanticipated increases in demand for cytotoxic drugs from the veterinary sector that led to erratic stocks, especially in early 2018.

In light of such vulnerabilities to existing supply chains, procurement challenges emerged as a critical determinant of access. A lack of central coordination has resulted in CCD procurement that is poorly calibrated to need, and highly susceptible to both drug shortages and increased manufacturing-to-receipt time. Participants indicated that the lack of nationally coordinated public procurement of CCD, coupled with the unavailability of locally manufactured CCD, serves to both limit drug availability and inflate price. Abstention from institutional and national-level CCD procurement was seen as a major contributor to drug shortages and price inefficiencies through loss of economies of scale. Principal barriers to public procurement noted by participants include: persistent perception of oncology drugs as a risky investment; hesitation of private suppliers to enter into supply contracts with the government due to payment delinquency; and non-response of oncology suppliers to open national tenders. Participants further suggested that institutions were deterred from procuring CCD as a result of a perceived lack of demand that would potentially lead to drug expiry—a situation exacerbated by competition with private retail pharmacies offering select drugs at wholesale prices. A number of participants noted that existing modes of fractured procurement, in conjunction with small-volume tenders, result in delays in drug order processing. Drug manufacturing companies are often compelled to pool multiple orders until a minimal number of vials is met; the added time required for drug production and shipping results in an order fulfilment time of approximately 3 months. Further delays in obtaining FDA approval also emerged as an issue for CCD suppliers.

Participants referenced a range of top-down and grassroots strategies to combat erratic drug availability—ranging in focus from market approval and procurement to distribution and supply management. National and regional approaches by the FDA and West African Health Organization (WAHO) to streamline regulatory approvals were cited as promising levers to enhance availability. WAHO’s West Africa Medicines Regulations Harmonization Project harmonises product registration requirements and procedures between Economic Community of West African States member states.28 The intended goal is to incentivise pharmaceutical companies, suppliers and manufacturers to supply CCD to the small Ghanaian market and foster local antineoplastic production, with a view to expedited drug registration and decreased time-to-market across the region. The FDA’s fast-track drug registration process was also highlighted in this context. In addition to the orphan drug category, the FDA has enacted the guidelines which decrease the application processing time for qualified medicinal products from 6 months to 90 days.29 Oncology drugs and paediatric formulations are eligible for the fast-track process, in the hopes of significantly reducing the time to market availability.

Implementation of a logistics management information system (LMIS) was highlighted as a critical mechanism to improve supply management of medicines in Ghana. As current software systems are siloed by programme drug portfolio and location, participants heralded government plans to launch an LMIS that include all medicine products, including cancer medicines, in public facilities. This was widely perceived as a promising means to facilitate distribution and circulation of medicines between public sector health facilities, with positive knock-on effects for availability. In response to procurement challenges, Ghana has undertaken framework contracting, a nationally-coordinated bulk purchase of 54 NEML-listed essential medicines. While CCD are not yet included, respondents were optimistic that the future inclusion of CCD could render medicines more affordable and readily available.

In recognition of the complexity and cost implications of drug importation, participants from the pharmaceutical sector and government spoke to the merits of generating opportunities for local production, arguing that drugs produced domestically would be cheaper and more readily available. Participants stressed the absence of domestic production capacity, the resource-intensive nature of the
enterprise and the lack of aggregate demand for oncology drugs as major deterrents to the development of local antineoplastic producers. Both the Ghana National Medicines Policy (GNMP) and civil servants emphasised that to foster local production, strategies must include: tax exemption for imported raw materials; quotas on the importation of select already locally-produced agents; and government financial assistance for local manufacturers in the form of low-interest capital loans.25

Where such policies have failed to prevent recurrent drug shortages, grassroots-level actors have implemented ad hoc strategies to combat poor availability—often with ancillary impacts on affordability, both positive and negative. Participants highlighted two beneficial strategies that parents and health providers have deployed to circumvent waste mitigation and high drug costs. First, families group purchase, share both costs and medicines. Second, health providers engage in batched administration, coordinating patient appointments to ensure that available vials are given to multiple children and wastage is minimised. In the face of persistent shortages and acute need, CCD suppliers often contract private agencies to acquire drugs and courier them to the point of sale, at a considerable cost to patients.

**Quality**

Concerns related to the quality of available CCD arose recurrently and were often connected to availability and affordability issues. Participants highlighted a common cost-control practice of institutional sourcing and procurement from markets with lower drug prices, with inadvertent effects on CCD quality. Accordingly, many participants expressed concern that high drug costs were contributing to the proliferation of low-quality drugs. Existing quality assurance measures for cancer drugs in Ghana are weak and piecemeal. The FDA’s post-market surveillance programme relies mainly on clinician reporting of adverse drug reactions or ineffectiveness. In addition, participants expressed dissatisfaction with the delay in FDA response after a drug is reported. While hospital manufacturing centres have aided in the conversion of certain medicines, widespread concern persists among paediatric healthcare providers about substandard quality related to CCD compounding, limiting the availability of safe and effective child-friendly formulations and constraining optimal dosing.

Our findings reveal that access to CCD in Ghana is the product of a dynamic tension between received policy, regulatory and governance structures and evolving health system realities (figure 3). The provision of CCD within the Ghanaian health system is mediated by a complex series of inter-relationships between public and private sector institutions. These relationships are conditioned by national policy legacies and institutional path dependencies tailored to communicable disease and primary care priorities. The lack of centralised mechanisms for data collection and management on childhood cancer incidence and outcomes has hampered political prioritisation and evidence-informed planning. Weak regulatory controls on drug pricing, limited financing options and fractured procurement practices have engendered siloed pharmaceutical management and supply systems, with ramifications for CCD availability, affordability and quality.

**Figure 3** Ghanaian health system determinants influencing childhood cytotoxic drug access. CC, childhood cancer; CSO, Civil society organization; EML, Essential Medicines List; FDA, Food and Drug Authority; KATH, Komfo-Anokye Teaching Hospital; KBTH, Korle-Bu Teaching Hospital; NHIS, National Health Insurance Scheme.
DISCUSSION

Our study contributes to a small, but growing body of literature that augments understanding of health policy and system considerations for children with cancer in LMICs, and yields valuable theoretical and practical insights relevant to the analysis of drug access in health system context. First, our results underscore path dependence in Ghanaian health policy. Path dependence implies that past decisions frame and limit presently available ones, amplifying the downstream effects of policy over time and constraining future policy options. The policy legacies fostered by sustained system focus on communicable disease control and primary care strengthening—issuing from longstanding domestic and international health governance priorities—have engendered neglect in the realm of NCD drug policy, including childhood cancer, despite the ongoing epidemiological transition in the country. Second, recognition of the dynamic interplay between core components of access, and the impact of health system structures and policies, underscores the value of complex adaptive systems theory for understanding drug access. Complex systems are characterised by interdependence of their component parts and cyclical causal pathways between them. Our findings highlight the close inter-relationships between principal dimensions of drug access—affordability, availability and quality—and the foundational impact of governance on these dimensions, separately and in combination.

Together, the path dependence of drug policymaking and interdependence of its downstream effects have cultivated a health system environment minimally receptive to growing childhood cancer needs. The absence of dedicated political priority for childhood cancer amidst a broader push for enhanced NCD coverage has stymied the development of policies on drug procurement, pricing and quality assurance that incorporate childhood cancer, hampering the inclusion of paediatric cytotoxic and supportive care agents in both national and institutional pharmaceutical management practices. Further, the limited alignment between the WHO EMLc and Ghana NEML in respect of essential cytotoxic medicines for children is both a symptom and determinant of a drug policy environment that largely neglects childhood cancer. It underlines a lack of explicit priority in agenda-setting at the national level, and contributes to exclusion from legislative and regulatory provisions, like bulk procurement through framework contracting, that would ensure procurement through established public channels.

Weak data systems compound this neglect by constraining evidence development that could document the scale and contours of the problem, and thereby help surmount it. Coupled with the historical exclusion of childhood cancer from public health coverage in Ghana—a critical demand-side determinant of drug affordability—this lack of evidence has constrained the ability of institutions to forecast accurately, and thus procure and stock essential childhood cancer medicines efficiently. The upshot has been devolution of procurement and supply management responsibilities to private markets, themselves distorted by widespread barriers to individual patient demand in line with need. In the absence of centralised public procurement and sustained institutional provision of CCD, the capacity for public sector quality assurance is limited to the point of initial market entry. The strong incentive for low-cost alternatives that stem from affordability issues has driven multi-source procurement through weakly regulated private channels, compounding erratic availability with concerns of substandard quality. Our analysis of drug pricing and stock data stresses the vulnerability of the system to procurement inefficiencies. This combination of factors relegates real-world access to a function of grassroots efforts by providers, patients and local communities, with resultant inefficiencies and inequities as documented in other LMIC contexts. The interconnectivity across sectors, actors and system levels reveals what Atun refers to as ‘dynamic complexity’; such interconnectivities warrant greater attention in policy development and implementation.

With the recent emergence of the Ghana Cancer Board and the National Steering Committee for NCDs, a greater opportunity has emerged for coordinated planning and monitoring for childhood cancer care, particularly in light of plans to reform the now-outdated cancer control policy. Recognition of the need for complex systems thinking to apprehend challenges to CCD access can help prioritise high-yield policy responses to them. Policy recommendations and implications are summarised in table 3. First, data infrastructure must be improved and used in drug policy development and implementation. The development of quality population-based cancer registration and evidence-driven pharmaceutical management practices are foundational to evidence-informed policy on cancer control, including drug access. Ultimately, such data could inform nationally coordinated quantification and procurement of CCD that leverages economies of scale to speed manufacturing-to-receipt time, assure consistent availability and reduce drug cost.

Strategies focussed on drug affordability, incorporating both demand-side and supply-side reforms, constitute a second key domain for focussed policy response. CCD and supportive care medicines are financially prohibitive for the majority of patients. Attention to cost-related barriers and public coverage through NHIS could significantly improve access to CCD in Ghana and other comparable health systems. While treatment is expensive, evidence shows that childhood cancer treatment in Ghana and other LMICs is cost-effective. Efforts to consolidate existing national pricing control strategies will provide essential supply-side complements to health financing reforms. These insights are of direct relevance to evolving efforts at health system strengthening and policy reform in line with the emerging prioritisation of NCDs and universal healthcare coverage expansion in Ghana.

Study strengths and limitations

This study has a number of theoretical and methodological strengths. First, it provides an in-depth analysis of CCD access that combines granular data on drug availability and price with varied system-level stakeholder perspectives on access dynamics to generate a comprehensive...
picture of access to CCD. Further, this study combines childhood cancer-specific analytical tools, such as the POSIT analytical framework, and systems-based theory on access to medicines, to engender insights into CCD access that are sensitive to health system context.

The study also has several methodological limitations. Retrospective analysis of CCD stocks and prices relied on existing institutional record-keeping processes, with potential implications for data accuracy. One consequence of this was the practical need to source data on drug availability variably from patient-level and supplier-level perspectives across institutions of interest. For KBTH, the WHO definition of stock-out at the point of patient care was adopted: we analysed Rock Chemist retail stocks of cytotoxic medicines, which reflect direct procurement by parents on an as-needed basis; supportive care drug data were obtained from the Child Health Unit pharmacy at KBTH, which likewise reflect patient-level availability. By contrast, as Rock Chemist is the primary supplier of CCD in Ghana, we analysed availability of cancer drugs at KATH at the supplier level. However, significant discordance between KATH pharmacy availability and Rock Chemist availability of these single-source agents is unlikely, and analysis at the supplier level represents a conservative assumption, as pharmacy-level stock-outs may be readily mitigated through reordering from the local supplier, where the latter has available stocks; supplier-level stock-outs were therefore felt to

### Table 3  Policy and planning recommendations and goals

| Stakeholder level | Policy option | Goals |
|-------------------|---------------|-------|
| **Challenge 1: Weak data systems and evidence for political prioritisation and public awareness** | | |
| National          | Formal inclusion of childhood cancer in national NCD policy and planning, for example, broadened scope of inclusion of childhood cancer in National Cancer Control Strategy | Catalyse opportunities for greater health system prioritisation of childhood cancer |
| National Institutional | Development of streamlined national and institutional cancer registration and data management systems | Improve data collection and management procedures for evidence-based policy and planning |
| National          | Strengthen systems for forecasting paediatric cancer drug needs | Minimise procurement inefficiencies |
| National Institutional | Implementation of a logistic management system | Enables real-time tracking of institutional tenders, stocks, and prices |
| National          | Increase public awareness of childhood cancer through national health promotional campaign |
| National Institutional Community | Investment in Ghana Cancer Board, National Steering Committee for NCDs and relevant stakeholders to advance advocacy for policy reform | Increase public awareness |
| National          | Improve early recognition/diagnosis of childhood cancers |
| National          | Elevate priority of childhood cancers on policy agendas |
| **Challenge 2: Cancer drug affordability, availability and quality constraints** | | |
| International     | WHO pre-qualification of essential childhood cancer drugs | Streamline regulatory processes for importation of quality generic cytotoxic and supportive care drugs for childhood cancer |
| National Private pharmaceutical | Consolidate existing national pricing control strategies through regulatory reform |
|                     | Decrease taxation on imported drugs | Improve drug pricing and affordability |
|                     | Coordinated public procurement of childhood cancer drugs | Leverage economies of scale across institutions to improve affordability |
|                     | Inclusion of childhood cancer in national health insurance scheme benefits package | Increase adherence/minimise treatment abandonment |
| National           | Expedited FDA approval processes | Minimise stock-outs through decreased order latency and product diversification |
| **Generic substitution as a policy directive** | | |

FDA, Food and Drugs Authority; NCD, non-communicable diseases.
CONCLUSION

Ghana’s NCD control efforts require concerted evidence and policy development tailored to emergent health system realities. Efforts to improve access to essential medicines for children with cancer in LMICs, including Ghana, hinge on a nuanced understanding of system-level impediments to access. Our study highlights the impacts of existing policy, regulation and health service delivery approaches on CCD availability, affordability and quality in Ghana, emphasising the role of inherited political priorities and system interdependence in perpetuating access barriers. We identify pliable points for focussed policy reform to improve CCD access in Ghana and provide an approach to comparable analyses in other health system contexts. As an economic leader in West Africa, and priority partner country for the WHO’s Global Initiative for Childhood Cancer, the strategies Ghana adopts have the potential to influence policy environments in other countries in the region, laying the foundations for broader improvements in access to essential medicines for children with cancer and other NCDs.

Acknowledgements We would like to express our sincere gratitude to all the study participants. We also thank Dr Akya Bonney, Angela Appiyeyei and to the staff at Rock Chemist for their assistance with the qualitative and quantitative data collection, and to Amanda Giancola for her assistance with qualitative data management. We also extend our gratitude to Supriya Parikh, Bryan Maguire and Dr Derek Stephens for assistance with the quantitative analysis of the drug stock data.

Contributors AD and LR conceived and designed the study. RB performed the statistical analysis. RB led qualitative data collection, with assistance from AD and LR. RB prepared the first draft of the manuscript. KP and AD contributed to data analysis, interpretation of results and sequential revisions of the manuscript. All authors contributed to study design, critically revised the manuscript and approved the final version. As corresponding author, AD accepts responsibility for the work, full access to all the data and the decision to publish. AD attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Funding This work was supported by a SickKids Centre for Global Child Health Catalyst Grant.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval Institutional approval was obtained from the Research Ethics Boards at the Hospital for Sick Children in Toronto, Canada and at the Korle-Bu Teaching Hospital in Accra, Ghana.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

Interview transcripts, though anonymised, may reveal the identity of participants, given the limited number of stakeholders involved in childhood cancer care and drug policy in Ghana; excerpts will be made available upon reasonable request.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/.

ORCID iD

Avram Denburg http://orcid.org/0000-0003-0393-0742

REFERENCES

1 World Health Organization. Noncommunicable diseases progress monitor 2017, 2017. Available: https://www.who.int/nmh/publications/nccd-progress-monitor-2017/en/ [Accessed 12 Feb 2019].

2 Wang ZJ, Yeh JM, Bhakta N, et al. Estimating the total incidence of global childhood cancer: a simulation-based analysis. Lancet Oncol 2019;20:483–93.

3 Rodriguez-Galindo C, Friedrich P, Alcasabas P, et al. Toward the cure of all children with cancer through collaborative efforts: pediatric oncology as a global challenge. J Clin Oncol 2015;33:3065–73.

4 Renner L, Shah S, Bhakta N, et al. Evidence from Ghana indicates that childhood cancer treatment in sub-Saharan Africa is very cost effective: a report from the childhood cancer 2030 network. J Glob Oncol 2018;4:1–9.

5 World Health Organization. Global initiative for childhood cancer. Available: https://www.who.int/cancer/childhood-cancer/en/ [Accessed 12 Feb 2019].

6 Gupta S, Rivera-Luna R, Ribeiro RC, et al. Pediatric oncology as the next global child health priority; the need for national childhood cancer strategies in low- and middle-income countries. PLoS Med 2014;11:e1001656.

7 Eden T, Burns E, Freccero P, et al. Are essential medicines available, reliable and affordable in low-middle-income countries? J Cancer Policy 2019;19:100196.

8 Mehta PS, Wnirnkowski JT, Petrelli JAS, et al. Essential medicines for pediatric oncology in developing countries. Pediatr Blood Cancer 2013;60:889–91.

9 Denburg AE, Knaul FM, Atun R, et al. Beyond the bench and the bedside: economic and health systems dimensions of global childhood cancer outcomes. Pediatr Blood Cancer 2014;61:572–6.

10 Denburg A, Arora B, Arora RS, et al. Access to essential medicines for children with cancer: a joint SIOP-CCI position statement. Lancet Oncol 2017;18:20–2.

11 Denburg A, Cuadrado C, Alexis C, et al. Improving childhood cancer care in Latin America and the Caribbean: a PAHO childhood cancer Working group position statement. Lancet Oncol 2017;18:709–11.

12 Frimpong G, Ofori-Kwakye K. Access to essential medicines in Ghana: a survey of availability of children’s medicines in medicine outlets in the Ashanti region. J Appl Pharm Sci 2016;6:8–03–8.

13 Network EP. Children medicines in Uganda: an investigation into availability and factors impacting the access. network EP, from the shelf series, 2011.

14 Ghana National Drugs Programme. Assessment of availability and price, prescribing, dispensing and use of medicines in palliative care in two teaching hospitals, two regional hospitals and for district hospitals. Ghana National Drugs Programme, 2017.

15 Creswell JW, Clark VLP. Designing and conducting mixed methods research. Thousand oaks, CA: Sage publications, 2017.

16 Fetter MD, Curry LA, Creswell JW. Achieving integration in mixed methods designs-principles and practices. Health Serv Res 2013;48:2134–56.

17 World Health Organization. Who model lists of essential medicines. Available: https://www.who.int/mediacentre/publications/essentialmedicines/en/ [Accessed 25 Oct 2019].

18 Masen B, Force LM, Friedrich P, et al. Pediatric oncology system integration tool (POSIT); a health systems performance assessment framework for childhood cancer care in low- and middle-income countries. J Cancer Policy 2020;23:100208.

19 Management Sciences for Health. MDS-3: managing access to medicines and health technologies. Arlington, VA: Management Sciences for Health, 2012.

20 Management Sciences for Health. International medical products price guide, 2015 edn. Medford, MA: Management Sciences for Health, 2016.
21 Gelders S, Ewen M, Noguchi N, et al. Price, availability and affordability: an international comparison of chronic disease medicines. WHO/HAI, 2006.

22 Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol 2006;3:77–101.

23 Ministry of Health. National strategy for cancer control in Ghana 2012-2016. Ghana Ministry of Health, 2011.

24 Ministry of Health. National health policy: creating wealth through health. Ghana Ministry of Health, 2007.

25 Ministry of Health. Ghana national medicines policy 2017. Ghana national medicines policy 2017, 2017.

26 FDA. Guidelines for registration of an orphan drug 2019. Ghana Food and Drug Authority, 2019.

27 Ghana News Agency. ‘Health Ministry inaugurates National Medicine Price Committee’, My Joy Online, 2019. Available: https://www.myjoyonline.com/lifestyle/2019/July-4th/health-ministry-inaugurates-national-medicine-price-committee.php [Accessed 26 Jul 2019].

28 West African Health Organization. Harmonization of medicines registration in the ECOWAS region. West African Health Organization. Available: https://www.wahoeas.org/web-ooa/en/actualites/cote-divoire/harmonization-medicines-registration-ecowas-region/ [Accessed August 24 2019].

29 FDA. Guidelines for the registration of medicinal products classified for fast track processing 2019. Ghana Food & Drug Authority, 2019.

30 Hall PA, Taylor RCR. Political science and the three new institutionalisms. Polit Stud 1996;44:936–57.

31 Pierson P. Increasing returns, path dependence, and the study of politics. Am Poli Sci Rev 2000;94:251–67.

32 World Health Organization. Primary health care: report of the International Conference on primary health care, Alma-Ata, USSR, 6-12 September 1978 / jointly sponsored by the world Health organization and the United nations children’s fund. World Health Organization, 1978.

33 Pierson P. When effect becomes cause: policy feedback and political change. World Poli 1993;45:595–628.

34 Bigdelli M, Jacobs B, Tomson G, et al. Access to medicines from a health system perspective. Health Policy Plan 2013;28:692–704.

35 Rogers PJ. Using programme theory to evaluate complicated and complex aspects of interventions. Evaluation 2008;14:29–48.

36 Paina L, Peters DH. Understanding pathways for scaling up health services through the lens of complex adaptive systems. Health Policy Plan 2012;27:365–73.

37 Arney L, Yadav P. Improving procurement practices in developing country health programs. Ann Arbor: William Davidson Institute, University of Michigan, 2014.

38 Oluka PN, Ssennoga F, Kambaza S. Tackling supply chain bottlenecks of essential drugs: a case of Uganda local government health units. 4th International Procurement Conference, 2013: 26–8.

39 Seoane-Vazquez E, Rodriguez-Monguio R. Access to essential drugs in Guyana: a public health challenge. Int J Health Plann Manage 2010;25:2–16.

40 Magazidine BP, Ward K, Leng HMJ, et al. Inefficient procurement processes undermine access to medicines in the Western Cape Province of South Africa. S Afr Med J 2017;107:581–4.

41 Atun R. Health systems, systems thinking and innovation. Health Policy Plan 2012;27 Suppl 4:iv4–8.

42 Martel YM, Chiwapo S, Grover S, et al. Availability of who essential medicines for cancer treatment in Botswana. J Glob Oncol 2018;4:1–8.

43 Fuentes-Alabi S, Bhakta N, Vasquez RF, et al. The cost and cost-effectiveness of childhood cancer treatment in El Salvador, central America: a report from the childhood cancer 2030 network. Cancer 2018;124:391–7.

44 Fung A, Horton S, Zabih V, et al. Cost and cost-effectiveness of childhood cancer treatment in low-income and middle-income countries: a systematic review. BMJ Glob Health 2019;4:e001825.

45 Denburg AE, Lafer N, Mutyaba I, et al. The cost effectiveness of treating Burkitt lymphoma in Uganda. Cancer 2019;125:1918–28.