Routine Use of DHIS2 Data: A Scoping Review

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Abstract

BACKGROUND:

In terms of health service planning and delivery the use of information at different levels in the health system is vital, from influencing policy, to program action, and to evidence informed practices. However, having good data or access to good data does not necessarily imply data use. For information to be used relevant data needs to be collected, processed and analysed in an accessible format. The problem of little or no data use is widespread and has been evident for decades.

The DHIS2 software platform supports routine health management for an estimated 2.4 billion people and is used in over 70 countries. DHIS2 is by far the largest and most widespread software for this purpose and adopts a holistic socio-technical approach to development and implementation. With this approach and the rapid and extensive scaling of DHIS2 we questioned whether this has been matched with the increased scaling of improved information use. To date there has been no rigorous review of the documentation on how DHIS2 data is routinely being used for action and decision-making. This scoping review addresses this gap.

METHODS:

The five stage approach of Arksey and O'Malley and progressed by Levac et al., was followed. Three databases (PubMed, Web of Science and Embase) were searched, along with relevant conferences and postgraduate thesis. In total approx. 300 documents were reviewed with 18 documents being fully reviewed.

RESULTS:

Overall DHIS2 data is being used but there are few detailed descriptions of this in peer reviewed or grey literature. We find that there is commonly a centralised versus decentralised pattern of use in terms of access to data and reporting data up in the system, and that the different conceptualisations of data use and how data use is conceptualised is not made explicit.

CONCLUSIONS:

We conclude with some suggestions on the way forward, namely: the need to document in more detail and share how data is being used, investigating how data was created and who uses the data, designing systems based on work practices and exploring and promoting forums in which we can have 'conversations' around data.

1. Background

In terms of health service planning and delivery the use of data at different levels in the health system is vital, from influencing policy, to program action and to evidence informed practice(1–3). There have been

global calls to action, consortia, and frameworks to support information within the remit of health systems strengthening, for example: the Paris Declaration of 2005 and the establishment of Health Metrics Network the same year: World Health Organization's Framework for Action; the focus on Strengthening Health Systems to Improve Outcomes in 2007; and the U.S. Global Health Initiative in 2011 (4). The rationale for these commitments is that better quality, relevant and comprehensive data will increase use of this data in action and decision making and ultimately improve health service delivery and health outcomes. However, having good data or access to good data does not necessarily imply data use (5–7). For data to be used relevant data needs to be collected, processed and analysed in an accessible format (5). Nevertheless, the problem of little or no data use is widespread and has been evident for decades (8–11).

For those reviews that examine data use these have focused more on challenges faced rather than sharing solutions or ways to address or mitigate these challenges of data use. For example, Lemma et al (2020) in their scoping review of interventions that aimed at improving data quality and use in routine health information systems in LMICs classified challenges in data quality and data use in relation to staff, resources, or infrastructure factors. In a systematic literature review Wickremasinghe et al (12) explored ways in which district administrators and health managers in LMICs use health data to make decisions, and found that there was a limited range of processes documented on the use of data for decision-making at district level.

A partial explanation is that more emphasis has been placed on data collection in low- and middle income countries (LMICs) than on data-use with evaluations of these systems focusing on statistical data processes and data quality, and less on how data are assimilated into practice (13). In other studies limited data use has largely been attributed to suboptimal quality of data generated by the routine health information systems, and the absence of a culture of information-use(14–16). This suboptimal quality of data may be due to unintended mistakes or due to deliberate misreporting , but that other factors that can contribute to poor quality can be under-reporting or no reporting due to time pressures, lack of motivation, too many forms to complete and a lack of understanding of the importance of data (7). Additionally, another possibility besides poor data quality is that there may be no standardized process for the usage of data (17, 18). So despite these reviews there is limited understanding or knowledge on how and what data is being used and the processes around this.

2. Data Use

Data use is not easy to define as both 'data' and 'use' can be conceptualised in many different ways. A delphi study of Information Scientists by Zins (2007) yielded more than 40 different definitions of data and Checkland and Holwell (1998) revealed 7 different definitions in Information Systems textbooks (quoted in 19). Jones (19) describes a number of assumptions that are made around data that we should question, such as all data are equal, that data represents a reality independent of themselves, that data exists independent of their use, that data are the base on which our understanding is built and that data represents the world objectively. When we question these assumptions then we realise that data does not

necessarily report reality, that data is not recorded in a vaccum and reflects a particular way in which the world can be viewed, that data is interpreted and can be non-empirical and that data can vary in its perceived value and quality. Once questioned in this way then we need to distinguish as Jones (19) suggests between "data in principle" as they are recorded, and the "data in practice" as they are used.

There are also different conceptualisations and hence definitions of data use. Manuals and reports on DHIS2 itself have referred to the information cycle as illustrative of the stages required before information is used (collection; processing; analyse; present; interpret and use). In this sense data use is defined as the last step in a **process** and fits the definition of use by Foreit et al: 'Decision makers and stakeholders explicitly consider information in one or more steps in the process of policy making, program planning and management, or service provision, even if the final decision or actions are not based on that information.' (20, p.5).

Nutley (4) interprets data use in decision-making in a similar manner : "… as the analysis, synthesis, interpretation, and review of data for data-informed decision-making processes, regardless of the source of data. 'Data-informed decision making,' then, refers to the proactive and interactive processes … that consider data during program monitoring, review, planning, and improvement; advocacy; and policy development and review." Nutley concludes that "… it is clear that data use goes beyond filling out data reporting forms at the various levels of a national health information system and the passive dissemination of reports and information products." (4, p.2). However, Nutley proceeds to extend this conceptualisation to the **purpose** of use.

Nutley (2012) categorises data use in terms of data and information regularly demanded, analysed, and synthesised, reviewed and used in (i) program review and planning; (ii) advocacy and policy development, and; (iii) decision-making processes. Nutley doesn't define each of these categories but classifies all three as the long term outcome of the use of data.

In addition to the aspects of process and purpose, the Health Metrics Network framework (21) can be used to illustrate variance in **content**. Reflecting the diversity of uses and users, also involving the wider community such as civil society, data use involves varied levels of data granularity and a wide range of information products.

We come back to this conceptualisation and definition of data use in the discussion but data use in this review was looked at in terms of going beyond data collection, form filling and the passive production and dissemination of reports or products. We thus looked at documents that either covered the process, purpose and/or content around DHIS2 data use – what Jones' (19) would distinguish as the use of 'data in practice'.

3. District Health Information Software 2 (Dhis2)

This study investigated the use of data in LMICs by focusing on DHIS2, as in LMICs DHIS2 is a prominent Health Management Information Systems (HMIS) platform and is typically used as national health

information systems for data management and analysis purposes, for health program monitoring and evaluation, as facility registries and service availability mapping, for logistics management and for various community-based services such as mobile tracking of pregnant mothers in rural areas. Increased commitments and investments in strengthening HMIS have occurred alongside increased support and adoption of DHIS2. The DHIS2 software platform has over the last decade seen tremendous adoption, and is supporting routine health management for an estimated 2.4 billion people. It is used in over 70 countries and is by far the largest and most widespread software for this purpose. So the question we may ask is whether the rapid and extensive scaling of DHIS2 has been matched with increased scaling of improved data use?

As Walsham (7) notes improved information requires an approach that combines the three elements of 'software philosophy, educating people and changing institutions' and continues to cite the work on the health information systems program HISP (22, 23) as a program that addresses information systems from all these perspectives. However, despite this 'we still see only limited evidence as to how health information systems have contributed to improved health outcomes, and to advancing the state of the poor in developing countries.' (7, p.196). So if DHIS2 is the largest global routine HMIS in LMICs, adopts a holistic socio-technical approach to development and implementation and data is still not being used for information, action taking and/or decision making then we need to explore what and why this is happening. However, there has been no rigorous review conducted on how DHIS2 data is being used despite the tremendous success recorded in scaling, implementation, improvements in data quality and data access.

In relation to rigorous reviews on data use and in particular in relation to DHIS2 there are few. A review of the utilisation of DHIS2 data in decision-making at the district, sub-district and community levels in selected districts of the Brong Ahafo region in Ghana, Odei-Lartey et al (24) explored the facilities routine meetings for evidence of decision-making. Though they concluded that the use of DHIS2 data to inform decisions was suboptimal they discovered that data was being used in relation to: discussions about the DHIS2 platform, action-oriented decisions taken based on findings from DHIS2 data, and actions taken to promote the usage of the DHIS2 platform. The 4 categories of action oriented decisions were: Performance recognition and role/responsibility revision, Shifting/mobilization of resources, Advocacy for more resources, and Formation/revision of policies/strategies. A recent literature review of DHIS2 (25) explored the strengths and operational challenges in the technical and functional aspects of DHIS2 in 11 countries, but didn't focus on data use. Additionally, these reviews focus on peer-reviewed literature and thus exclude a large amount of grey literature such as conferences papers and research thesis in this area.

This review therefore addresses this gap and focuses specifically on the documentation of routine use of the DHIS2 data for action and decision making.

4. Methods

Scoping reviews have been used widely 'to identify knowledge gaps, scope a body of literature, clarify concepts or to investigate research conduct' (26). They are useful 'when a body of literature has not yet been comprehensively reviewed, or exhibits a complex or heterogeneous nature not amenable to a more precise systematic review of the evidence' (27, p.141). Scoping reviews can also document research that informs and addresses practice (28). A scoping review does not include aggregation and synthesis of data nor does a scoping review include a quality assessment of the documents included (26).

Thus a scoping review suits our review question of mapping how routine DHIS2 data use been documented. The objectives were to review the literature (peer reviewed and grey) regarding DHIS2 data use, and to categorise key examples of use of DHIS2 data. This scoping review included a review of the peer reviewed literature, key journals and conferences, and thesis produced within the HISP programme. The primary research question was 'How is DHIS2 data being used routinely for action and decision making within the health system?' Sub-questions explored to address the primary research question included:

1. In what areas is it reported that DHIS2 data is being routinely used?
2. What examples are reported of DHIS2 data being routinely used for action and decision making?

The following databases were searched for peer reviewed literature: Pubmed, EMBASE and Web of Science, as these are deemed the most relevant for literature related to the topic (see search strategies in Appendix 1). Email alerts containing new articles published since the search was conducted in December 2020 were added to the original search. The time frame for the search was from when the first article was published in a given database to August 2021.

Due to language limitations, we included only English language articles. Hand searching of reference lists of studies deemed to be highly relevant to the review question were checked to identify other relevant studies. Grey literature included the International Federation for Information Processing: Working Group 9.4 (IFIP 9.4) conferences and the Post Graduate (MSc and PhD) thesis from the Health Information Systems Programme (HISP) in the Dept of Informatics at the University of Oslo. A review of evaluations and assessments of DHIS2 internal to HISP were conducted as part of a separate study by the first author (EB) but didn't reveal many additional detailed examples of data use that were not included in the other publically available documents. These internal reports were not included as part of the scoping review and this meant that as all the material reviewed is publically available and thus no ethical clearance was needed to conduct the review.

The two authors (EB & JS) analysed the abstracts and the full articles for review according to the inclusion or exclusion categories separately. Where there was any conflict the authors met and resolved the conflicts. There were other existing groups within the department that were available if the conflict could not be resolved between the two authors, but most of the conflicts was around ambiguity on the level of detail required for inclusion rather than whether the article met the inclusion or exclusion criteria. In these cases, the article was included in the full text review.

As noted the focus for this review was solely on DHIS2 (and previous versions of DHIS). Inclusion criteria were therefore that research and conference articles were peer reviewed and described how the data from DHIS2 was being used for action or decision making OR that the Grey literature described how the data from DHIS2 was being used for action or decision making. Exclusion criteria were:

i. Articles which focus on use of data for action or decision making not from DHIS2;

ii. Articles that evaluate or assess the *needs* of the health system in relation to DHIS2 or using DHIS2 data;

iii. Articles that describe/evaluate quality of data;

iv. DHIS2 data used with other data sources with purpose of validating or highlighting deficiencies of the datasets;

v. Articles that describe theoretical or conceptual frameworks only that could improve DHIS2 data use;

vi. Articles that describe the analysis and products of data only with no description in relation to how this analysis or product is used

vii. Articles that mention data use but provide no examples of how it is used

viii. Non-English language studies.

The JBI Guidelines approach of Peters et al., (27) was followed and included the following steps: defining and aligning the objective/s and question/s; developing and aligning the inclusion criteria with the objective/s and question/s; describing the planned approach to evidence searching, selection, extraction, and charting; searching, selecting, charting and summarising the evidence. The protocol was initially shared with the Heritage Project: Designing for Data Use research group at the University of Oslo for input.

The five stage approach of Arksey and O'Malley (28) and progressed by Levac et al., (29) was followed: i) identifying the research question; ii) identifying relevant studies; iii) study selection; iv) charting the data; v) collating, summarising and reporting results.

Duplicates were removed electronically and checked by hand by EB. Both authors independently screened titles and abstracts using covidence software for inclusion/exclusion. Disagreement between coders was resolved between the team members, though as mentioned internal research groups were available to consult with but this was not needed. For full article review both authors agreed on inclusion and exclusion independently and resolved any conflicts - again there was no need to bring in other groups as conflicts were easily resolved.

An extraction template was agreed upon and EB and JS extracted the full articles and grey material using this template. The data extraction template contained: author(s); year of publication; study title; journal/document source; study location; level of health system and health programme; study rationale; and description of use of data. Covidence software was used to assist with the process. Data was charted and exported from Covidence into excel. Standard descriptive information of included texts such

as study site, year of publication, type of publication and health level and programme was conducted using this excel spreadsheet. Study rationale and description of data from the charted data was subsequently categorised in relation to the focus of the study in terms of data use purpose, content or process.

The findings from the scoping review were presented to Paper Development Seminar Series at the Department of Informatics, University of Oslo and subsequently shared with other research groups and key individuals external to University of Oslo for comment. This sharing of early drafts was to validate the data that was included and to provide an opportunity for suggestions on any other articles or documents, especially grey literature, that we may have missed. The sharing was also a means to further the discussion on what could be done to document use of DHIS2 data and the different conceptualisations around 'data use'.

The two authors are currently part of HISP. EB did her PhD related to an earlier version of DHIS and worked with colleagues from HISP for approx. 15 years ago in South Africa. EB joined the HISP global team as a guest researcher for 12 months at the end of 2020. JS has been working with HISP at country level implementation and as a researcher with the UiO for nearly two decades. The implications are that we can be deemed 'insiders', but as noted in Byrne et al (30) there are advantages and disadvantages to the 'insider' versus 'outsider' debate. Additionally, following the systematic approach of a scoping review and sharing findings with key stakeholders has lent rigour to this review that hopefully will give a clear interpretation of the data found.

5. Results

Findings are presented in two parts – a descriptive analysis of the texts included (5.1) addressing sub-question 1 and categories of DHIS2 data use reported (5.2) addressing sub-question 2.

5.1 Description of texts included

A total of 18 documents were included in the review – Figure 1 illustrates the process by which the documents were included and excluded and Table 1 includes a brief description of the full text documents included in the review. The included texts were mainly from the field of development informatics (the IFIP9.4 conference), within the health services journals or as part of a thesis. Interestingly only 2 of the articles were in informatics journals perhaps indicating the focus on the design, implementation and analytics in these journals and not actions taken or decisions made based on the data collected (see Figure 2).

Table 1: Full texts included in review

Author(s)	Year	Title	Journal
Asah, Nielsen (31)	2017	Challenges for Health Indicators in Developing Countries: Misconceptions and Lack of Population Data	14th IFIP 9.4 WG Conference
Begum, Khan (32)	2020	Perceptions and experiences with district health information system software to collect and utilize health data in Bangladesh: a qualitative exploratory study	BMC Health Services Research
Biemba, Chiluba (33)	2017	A Mobile-Based Community Health Management Information System for Community Health Workers and Their Supervisors in 2 Districts of Zambia	Global Health: Science and Practice
Biswas (34)	2017	Shifting paradigm of maternal and perinatal death review system in Bangladesh: A real time approach to address sustainable developmental goal 3 by 2030	F1000Research
Braa, Heywood (8)	2012	Improving quality and use of data through data-use workshops: Zanzibar, United Republic of Tanzania	Bulletin of the World Health Organization
Chanyalew, Yitayal (35)	2021	Routine health information system utilization for evidence-based decision making in Amhara national regional state, northwest Ethiopia: a multi-level analysis	BMC Medical Informatics and Decision Making
Khan, Cruz (36)	2019	Bangladesh's digital health journey: reflections on a decade of quiet revolution	WHO South East Asia J Public Health
Klungland (37)	2011	The Implementation of the District Health Information System in Mtwara and Lindi Regions in Tanzania	MSc Thesis
Kossi, Sæbø (38)	2013	Developing decentralised health information systems in developing countries – cases from Sierra Leone and Kenya	The Journal of Community Informatics
Moyo (39)	2017	Transformational Feedback: Breaking the vicious cycle of information use in Health Information Systems - A case from Malawi.	PhD UiO
Nagbe, Yealue (40)	2019	Integrated disease surveillance and response implementation in Liberia, findings from a data quality audit, 2017	Pan Afr Med J
Nguyen and Nielsen (41)	2017	From Routine to Revolt: Improving Routine Health Data Quality and Relevance by Making Them Public	14th IFIP 9.4 WG Conference
Nicol, Bradshaw (15)	2017	Perceptions about data-informed decisions: an assessment of information-use in high HIV-prevalence settings in South Africa	BMC Health Services Research
Odei-Lartey, Prah (24)	2020	Utilization of the national cluster of district health information system for health service decision-making at the district, sub-district and community levels in selected districts of the Brong Ahafo region in Ghana	BMC Health Services Research

Author(s)	Year	Title	Journal
Ogega (42)	2017	Data use challenges and the potential of live data visualization tools: A case study of health data-use workshops in Zambia	MSc UiO
Ohiri, Ukoha (43)	2016	An Assessment of Data Availability, Quality, and Use in Malaria Program Decision Making in Nigeria	Health Systems & Reform
Vaidyanathan and Sahay (44)	2015	Using Health Management Information for Action: A Historical Analysis of Tamil Nadu, India	13th IFIP 9.4 WG Conference
Vila-Pozo and Sahay (45)	2019	Institutional Shaping of Affordances: Implications on Information Use in Global Humanitarian Organizations.	15th IFIP 9.4 WG Conference

The included studies were predominantly from Africa (with one comparing two African countries) and the remaining studies conducted in Asia. This is not surprising given that it is in these two regions that DHIS2 has been primarily adopted as the routine HMIS (see Figure 3).

There was a variety of levels within the health system that were investigated, though national level, one level below national (indicated as sub-national) and multi-level studies formed the majority of studies (see Figure 4).

Different programmatic areas were investigated though most of the studies focused on the HMIS rather than a specific programmatic area, with Maternal, neonatal and child health and Malaria being the most common programmes reviewed (see Figure 5).

Case studies were the most common study though there were quite a variety of study types as well as a mix of quantitative and qualitative data collection methods used (see Figure 6).

5.2 Categories of DHIS2 data use reported

A number of the articles reviewed which included the term 'data use' at times only mentioned that data was used or not used, the desire to improve data use, that data was analysed, or mentioned use being reported by people without any evidence or further description of use or how the data was obtained. In these cases, the documents were excluded from the full text review as they did not meet the inclusion criteria.

Though there was some evidence that DHIS2 data was being used for evaluation of interventions most of these reviews were not done routinely nor done by staff at an operational level within the health system. In many cases these studies were research studies testing a model or concept. For this reason, they were excluded from this review after full text review. Some examples included:

- Assessing technical inefficiency of hospitals (46)
- Evaluating indoor residual spraying in addition to long lasting insecticide-treated nets (47)

- Comparing effect of Performance Based Financing (PBF) & decentralized facility financing (DFF) on health service delivery (48)
- Determine effectiveness of a national mass distribution campaign of long-lasting insecticide-treated nets & indoor residual spraying on clinical malaria (49)

Most of the reported examples covered a mixture of process, content and purpose of routine data use.

5.2.1 Process

Examples were given in many of the documents reviewed of different information 'products', such as reports, dashboards, displaying of charts, and health bulletins. However, the process by which these outputs were generated and what they were used for is largely absent except in the cases where the reports were then shared and compared in review meetings (see 5.2.3). Nagbe et al (40) connects to some extent the data analysis with the action in terms of noting that '78% of the health facility use Bar chart as methods to detect outbreaks; 56% used trend lines; 33% used summary table and 11% used map to determine outbreaks' (40, p.4). Another example of an output was the use of maps to identify 'death spots' (34) at the sub-districts level which helped health managers to concentrate where interventions are needed.

Often the people who entered the data were not the same people who generated the products - in some cases it was the sstatisticians or 'IT' that were assigned to tabulate the data and share the generated summary reports with district and divisional health managers (32, 37) and in other cases there was the perception or culture that it was not the facility staff that were the key players in terms of using the data for decision making: 'the use of data in decision making is generally limited at national and sub national levels' (50) and 'district managers are not involved in decision-making as this is the responsibility of those at the central level' (31). However, Asah et al (31) note that nurses claimed that they used data to inform planning, but there was confusion over what constituted an indicator. Ogega (42) notes that whereas district staff were conversant with DHIS2 and the creation of dashboards and graphs, facility staff needed to ask district staff to produce reports as they had limited access to DHIS2

5.2.2 Content

From Figure 5 and 6 the studies covered a wide variety of programmes and different levels in the health system. In terms of the use of data most of the studies showed that data was been collected at a facility level and sent up to be compiled as quarterly reports which were then sometimes part of a review meeting or workshop. However, there was little detail on what indicators were compiled and what was contained in the reports. One example of a slightly more detailed description included: 'The project thus initiated the use of quarterly bulletins, a modest 4 page leaflet comparing all districts on a handful of health indicators, as well as some indicators on data quality' (38) alongside a photograph of the cover of one leaflet.

Some of the studies included details on how the authors determined whether data was used, but details on how this was determined were lacking. For example, Chanyalew et al (35) indicates that some comparative indicators were used: 'Of the total 386 departments investigated, 200 (52%) calculated target against achievement, and only 130 (33.7%) provided feedback to lower-level health workers. 50.3% had identified key indicators, 45.9% had health coverage calculated and 40.4% had decisions made on available information. As a result, the study revealed that only 46.9% of department heads utilized routine health information for evidence-based decisions.' However, how health coverage was calculated and for what programme was not indicated. Ohiri et al (43) mentioned that DHIS data were reportedly used most often for performance and/or supply chain management, but again no further details are provided.

There was an interesting case reported of the presentation of accident and emergency data over a festive period to the public and through the public media this resulted in different ministerial departments setting up meetings to validate the published data (41). At other times there were comments on making the data more public (44), but exact details on how this was done is not described.

5.2.3 Purpose:

In relation to Nutley's categories on the purpose of data use (4) there were only two examples of advocacy and policy development. Nguyen et al (41) described the situation where data on hospital Accident and Emergency were reported publicly to highlight awareness of the number of accidents during the festival period and to advocate for safer behaviour. This approach also resulted in triangulation of data from the Ministry of Public Security (MPS) and the Ministry of Health (MoH) and led to the process of querying differences in data. Odei-Lartey et al (24) in their review of use of DHIS2 data in Ghana concluded that data was being used for advocating for more resources and the formation/revision of policies/strategies (but at a District Government Hospital and not at facility or community level). However, no details of how this was done are given.

There were many examples of the use of DHIS2 data in terms of program review and planning. The most common areas were in terms of use of data in developing periodic plans, for the monitoring and comparison of performance, review meetings, and use of reports (See Table 2).

With respect to planning very little detail was given on how the DHIS2 informed the plans - in most documents there were simple statements made about DHIS2 data informing plans and in one case excerpts from the plan were presented (31). However, no further detail on how action plans were previously used or not used or how they planned to be implemented were included. There was some more detail given in terms of performance monitoring and comparison, with some detailed descriptions of league tables (38, 50), and details of the record of the discussions of performance monitoring teams (35), scoring of health facility performance (using DHIS2 data with other data) (36) and HMIS league tables (44). Overall though there was little detail given of how performance monitoring was conducted in terms of indicators used to assess performance, stakeholders involved in conducting the review and the process by which the feedback, if any, was given. Kossi et al (38) includes examples of certificates of improvement in Sierra Leone presented at the review meetings. Though comments were made that

performance improved as a result of these comparisons very few examples of what specific actions were taken are given.

More detail is provided on data review meetings and workshops and in a number of the examples presented there was also detailed descriptions on comparisons of performance and/or peer feedback on presentations. Braa et al (8) describe in detail a 5-day data-use workshop, how the workshops were run as well as a detailed list of actions and changes made in the planning and delivery of health services across a number of programmes. Begum (32) describes meetings for review at different levels of the health system that support the strengthening of the HIS. A District Information Meeting (DIM) in Rufunsa District in Zambia is described also in detail by Ogega (42) though the author outlines lack of a standard process and format to these meetings as well as noting that 'all that is being done is holding DIMs for procedural and formality purposes' (42, p.38).

Under the third category of Nutley of data use for decision-making processes Odei- Lartey et al (24) in their review categorised their findings on decision-making around action-oriented decisions taken based on findings routine HMIS data, discussions about the HMIS platform, and actions taken to promote the usage of the HMIS system. However, they found limited evidence in terms of data use in all these decision-making processes.

Chanyalew et al, (35) measured the proportion of routine health information utilisation using five core indicators: (i) presence of feedback provided by department heads to health workers in the department, (ii) evidence on the use of information for decision making, (iii) key performance indicators, (iv) evidence on health coverage, and (v) target achievements. They reported that the proportion of information use among department heads for decision making was estimated at 46%. However, this was based on responses made by health facility department heads on a collection tool developed from the Performance of Routine Information System Management (PRISM) tools.

Table 2
Examples of use of data for programme review and planning

Planning	Performance-based business planning (Asah et al 2017)
	National level evaluated programs when preparing annual report (Asah et al 2017)
	Visualise live data online- assists local planning, such as using death spot maps for interventions (Biswas 2017)
	Development and implementation of district and zonal action plans (Moyo 2016)
	Brief mention of data being used to detect outbreaks & data informing topics for health talks (Nagbe et al 2019)
	Shifting/mobilization of resources (Odei-Lartey et al 2020)
Performance	Performance monitoring at facility level with performance monitoring team discussions (Chanyalew er al 2020)
	Scoring health facility performance (using DHIS2 and HRIS with a physical visit and patient satisfaction) (Khan et al 2019)
	League tables (using excel with DHIS2 data) and Certificates of Improvement (Kossi et al 2013)
	Performance improvement and sharing experiences with others at peer review meetings (Moyo, 2016)
	HMIS league tables but feedback on how to improve ranking is poor (Vaidyanathan et al 2015)
	Performance recognition and role/responsibility revision (Odei-Lartey et al 2020)
Reports	Compiled quarterly reports at district level comparing results against targets (Asah et al 2017)
Review meetings	Monthly validation and review meetings sub-district, district and division levels (Begum et al 2020)
	Monthly feedback meetings at the district and national levels (Begum et al 2020)
	Quarterly data use workshops over 5 days and peer presentations at district level (Braa et al 2012)
	Peer review meetings/Information meetings over 2 days (Ogega, 2017)

A number of documents reviewed mention that action was taken based on DHIS2 data. For example, Ogega (42) notes that in the review meetings performances are discussed, action plans are drawn up and that a commitment to the plans is made - however there is no discussion of whether these plans are reviewed at the subsequent meetings and no description of the type of action that is included. Kossi et al (38) notes that chiefs took action based on league tables at chiefdom level and gives the example of improvements made in terms of institutional deliveries, but what action was taken is not described. Ohiri et al (43) explored use of data by asking questions in interviews around data use in relation to priority setting, surveillance, performance management, supply chain management, and advocacy and concludes that "DHIS data were reportedly used most often for performance and/or supply chain management" (43,

p.319). No examples are given. A number of examples of decisions made are included and are illustrated in Table 3. The most explicit account of actions and decisions made is included in Braa et al (8) where they provide a number of examples of improved data use resulting from their long term project for strengthening the HMIS in Zanzibar, the United Republic of Tanzania, 2005–2008.

Table 3
Examples of use of DHIS2 data for decision-making

Author	Decision making processes
Biemb et al 2017	CHWs use mobile application to: send weekly reports to health center supervisors on disease caseloads and medical commodities consumed, to make drug and supply requisitions, and to send pre-referral notices to health centers
Biswas 2017	Verbal autopsies used by local health managers for effective planning and reduction of such deaths in the future leading to: improvements in 1st delay (decision making) Improvements in 2nd delays (transferring to referral centre) and; improvement in referrals

Author	Decision making processes
Braa et al 2012	– Development of indicators to monitor emergency obstetric and neonatal care availability
	– Monitoring of quality of antenatal care and skilled birth attendance coverage
	– Introduction of maternal death audits
	– Introduction of the "couple year protection rate" indicator
	– Improved anaemia diagnosis in pregnancy Malaria Programme
	– Increased emphasis on bed net coverage
	– Monitoring of malaria in pregnancy
	– Treatment of confirmed rather than clinical cases, which in some instances resulted in data showing lower malaria incidence
	– Investigation of high dropout rates and coverage over 100%
	– Identification of double counting, resulting in improved quality control mechanisms
	– Introduction of diagnostic criteria to reduce misdiagnosis of pneumonia and malaria
	– Reduction of excessive data categories and age groupings
	– Routine collection of basic inpatient indicators such as average length of stay and bed occupancy rate
	– Focus on signal functions of emergency obstetric care and referrals, not just reporting of complications
	– Inclusion of laboratory data to check quality of diagnosis, particularly of malaria, tuberculosis, anaemia and syphilis
	– Improvement of OPD reporting to gain a more comprehensive idea of district-wide disease burden
	– Development of workload indicators to rationalize staffing needs and advocate for redistribution of staff away from central hospitals

6. Discussion

Different conceptualisations of data use are evident throughout the documents reviewed. There is the clinical/medical focus on the clinical encounter in terms of tracking patients and in management of the cases (curative); the engineering perspective of the manipulation of data into 'usable' formats, such as dashboards, and the public health perspective of data for prevention and health promotion. The definition used in our scoping review best fits the latter category – in terms of how is the data being used routinely to improve health care and service delivery at Primary Health Care levels. We thus excluded many documents that described using data to generate charts and reports unless there was a description of how those charts or reports were used or the process involved in their production.

It is also clear that very different conceptualisations of the purpose or type of action expected from data are embedded in the system. For example Kelly et al (51) question the more scientific 'decisionistic' focus on decision-making with the underlying 'control at a distance' ethos as opposed to processing data to provide for occasions to hold 'conversations that matter'. There is also recognition that evidence is socially and historically constructed - so along with different contexts different people will also interpret evidence differently – a point we noted above made by Jones in his questioning of the assumptions underlying what we mean by data (19). Related to this Mutale et al (52)(49)(52)(52)(49)(49)(49)(49)(48)(48)(48)(48) conclude in their review of design differences across their partnerships different theories of change lead to different perceptions on what information is needed, on who will use the information and also the manner in which that change is to expected take place. Madon et al (53) also argue that there is the need to design and implement health information systems for local decision-making and accountability rather than as 'mere reporting tools'. The view of HMIS as mechanisms for reporting can also be explained by centralistic attitudes to public sector management (see for example 54, 55), or to the reporting requirements experienced in partnerships with international organizations. Each HMIS thus gives what Jones terms 'a selective representation of the situation'(19).

The debates on the use of data for action taking or decision making aligns with the shift over time of what constitutes evidence. Though clinical trials and other evidence for clinical decision making and delivery of health care are important sources a more inclusive and sophisticated view of evidence has emerged (for example 56, 57-59) with the term evidence-'informed' practice becoming more used than evidence-'based' practice (60, 61). We can question whether the concept of 'data use' is best suited to what we have defined as 'data use' in this review or whether we should be promoting evidence informed action taking and decision making and adopting different language to describe this.

Another debate arose in the work of Asah et al (31) over who is expected to make decisions. In their case of Cameroon Asah et al note (31) that decisions are not expected to be made at the level below district and thus facility level users of the system have only permission to input data. Thus requests for information are made via the district office due to lack of access but also due to lack of expectations that data will be used in practice for decision-making or action. Wickremasinghe et al (12) apply Feldman and March (62) wider impediments to using data to the field of health administration and note that when the data gathers and users are separate this implies that the systems has been designed for monitoring rather than decision-making. Similarly many instances of DHIS2 focus on reporting data upwards and not the creation of data for use at operational or facility level – as we noted above what Madon et al (53) referred to as being used 'as reporting tools'. The end goal being a fixation with quality reporting rather than local use. Data quality and reporting rates are much easier to measure, and thus also easier for donor and governments alike to monitor and include in their evaluations and reports – to paraphrase Robert Chambers what gets measured counts (63) and gets done.

The theory of change in relation to data collection, processing and use is often simplistic. Even though there is increased recognition of a more holistic approach that embraces technical, behavioural and environmental/organisational elements to data use the main focus in documented HIS interventions

remains focused on challenges faced or technical solutions. Hoxha et al (64) study systematically reviewed technical, behavioural and organisational/environmental challenges that hinder the use of routine health information systems (RHIS) data in LMICs and the strategies implemented to overcome these challenges. They conclude 'Additional research is needed to identify effective strategies for addressing the determinants of RHIS use, particularly given the disconnect identified between the type of challenge most commonly described in the literature and the type of challenge most commonly targeted for interventions.' Of the studies identified in their review, there were twice the number of articles that described challenges to the use of RHIS compared to studies that described strategies to overcome them. Additionally, they found that even though technical challenges were the least commonly raised challenges in the literature 'strategies that incorporated technical components were the most prevalent, many of which involved a focus on developing indicators, registers and tools for data use improvement. On the other hand, only 13% of RHIS strategies address organisational or environmental challenges such as resource shortages, training, feedback and management though more than half the studies described these as challenges. Their review included DHIS2 interventions. So though it is acknowledged that technology on its own cannot be the sole driver for improved use and that technology can be used as a catalyst for change, there remains a disproportionate focus (or at least documentation) on the technical side of enabling data use. As Noir and Walsham remind us – Information and Communication Technologies in health often play a 'mythical and ceremonial role' and are not necessarily as means to support local action and decision making (65).

Returning to how we conceptualise data Jones (19) argues that we need to understand how data came to be (in terms of what is considered to be the phenomenon, what is considered to be the data about the phenomenon, what can be recorded, what gets chosen to be recorded and what actually gets recorded) as well as how is data used (what gets looks at, what gets found, what gets extracted, what gets understood and what actually gets used). Fundamentally he argues that data in practice is a culmination of a long series of steps and at each step there is the possibility of breakdown and the alteration of the data.

Overall though we are not concluding that routine data is not being used nor that there is no data culture at facility level. Dahal (66) presents an interesting case that illustrates that data is being used at the operational level by healthcare workers on a routine basis but that this is a manual system. The routine data is sent up manually in the system to be included in DHIS2, but this data is never reported or fed back so is not available at the lower level for use. There are also many examples of charts being presented on walls or in notebooks which are used to track performance and cases but this is not based on the data that has been entered into DHIS2. For instance, Damtew et al (67) report the case of a community health worker in South Africa drawing a map of the area illustrating where all the tuberculosis patients were living, so that the staff could go and follow-up if they did not show up for treatment. Likewise, Health Extension Workers in Ethiopia use hand drawn maps to plan daily activities. Similar community level data collection is reported by Moyo (39) in Malawi, but in all these cases this data was not entered into DHIS2. This can be related to a limitation of this review (see below) that by focusing only on DHIS2 data use other data use practises that are being conducted in parallel to DHIS2 are not being captured, but more importantly it raises questions as to why the data is not being used within DHIS2 when there is the

functionality within DHIS2 to do so. As Jones (19) notes there are costs to data - costs of producing, storing, retrieving and using data and we need to consider these when investigating use. Chrysantina et al (68) offer one possible explanation to non-use. They suggest that we often assume health staff, once trained, know how to use the various functions in DHIS2, but they find in their study that data literacy is a neglected area in medical school training and in the in-service DHIS2 training curriculum. Walsham (7) notes the relevancy of Gigler's (69) work on the different capabilities required on using the internet to improve well-being in a under resourced community in Bolivia. Besides having basic IT capabilities three groups of informational capabilities are needed – communication, information literacy and knowledge sharing. Asah (70) investigates the role of facility managers in empowering the staff in terms of such informational capabilities.

Walshams' (7) conclusions to his reflection summarise our discussion well. He raises 4 points:

- ICTs play a crucial role in improving data use but must be part of a more holistic approach that encompass the technological, social and institutional domains
- Capacity on data use for health workers requires strengthening
- software development has to be integrated with the work practices and computerised systems of healthcare workers
- Institutional change is required to place greater emphasis on local accountability and empowerment.

There are a number of limitations to this study. As mentioned earlier the focus on DHIS2 may mean we have missed some examples of documented data use practice, but given that DHIS2 is one of the largest routine HMIS the findings are likely to be similar to other systems. Having a keyword in the search as 'DHIS' may mean we have missed articles or documents that do not specifically include the software platform name in the article or may exclude documents that have another name for their RHIS which is built on DHIS2. We tried to address this through the sharing of the draft scoping review article with forums involved in DHIS2 as mentioned and to snowball from the reference lists of articles included. Additionally, one of the authors (JS) has worked with HISP for XX years and the other author (EB) had worked with HISP for a number of years 15 years ago and has joined HISP as a guest researcher for the year. As interpretive researchers we acknowledge that this scoping review is from a more internal perspective of HISP and that other perspectives and interpretations of the findings would also exist.

7. Conclusion & Implications For Practice And Research Gaps

Overall in response to our primary research question 'How is DHIS2 data being used routinely for action and decision making within the health system?' we can conclude that DHIS2 data is being used but there are few detailed descriptions of this in peer review or grey literature. In one way this is surprising given the extent of the scale of implementation and use of DHIS2 and the many anecdotal stories we in HISP have of data use – it is in fact HISP's raison d'etre. On the other hand, it is not surprising given that most of the literature on DHIS2 is written by HISP-affiliated people, who are increasingly occupied with making, implementing, and scaling software. A gap has grown steadily between use and technology development.

An effect of the increased collaboration with international agencies is that HISP has become more and more focused on technology and software development rather than an information system network as evidenced by the DHIS2 papers included in the review by Hoxha et al (64) – a focus on software use rather than data use.

Most commonly we see that DHIS2 data is being used primarily for planning and performance and for decision making and action taken. Whilst there are some rich descriptions of the examples given this could be improved if the use cases presented in these documents can be useful to other contexts. Aa three pronged way forward to improve data use is provided by Sahay et al (71) based on considerable case material from India and Africa. They argue the we need to start focusing on conversations around data, supporting communities of practice as an enabler of such conversations, and integrating IT solutions into the work processes and practices of the frontline healthcare worker. We would add to this that there is the need to document in more detail and share how data is being used which may require research into why this documentation and dissemination is not being done already. Further investigation into looking back at how data was created and who uses the data can help make more explicit the philosophy behind the creation of HMIS and the different conceptualisations of data, use and data use embedded in the HMIS.

Abbreviations

DHIS2 *District Health Information Software 2*

HISP Health Information Systems Programme

HMIS Health Management Information Systems

IFIP International Federation for Information Processing

IFIP9.4 International Federation for Information Processing: Working Group 9.4

LMICs Lower and Middle Income Countries

PRISM Performance of Routine Information System Management

RHIS Routine Health Information Systems

Declarations

Ethics approval and consent to participate

Not applicable as a desk review of material in the public domain

Consent for publication

Not applicable as no personal or individual data collected or reported on

Availability of data and materials

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Competing interests

Both authors are currently working in the HISP - this has been described in the text in terms of possible limitations, but also in terms of the opportunities it afforded.

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Authors' contributions

Besides initial conceptualisation of the scoping review by EB, both authors equally conducted the search, screening, analysis and write up.

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Johan Ivar Sæbø

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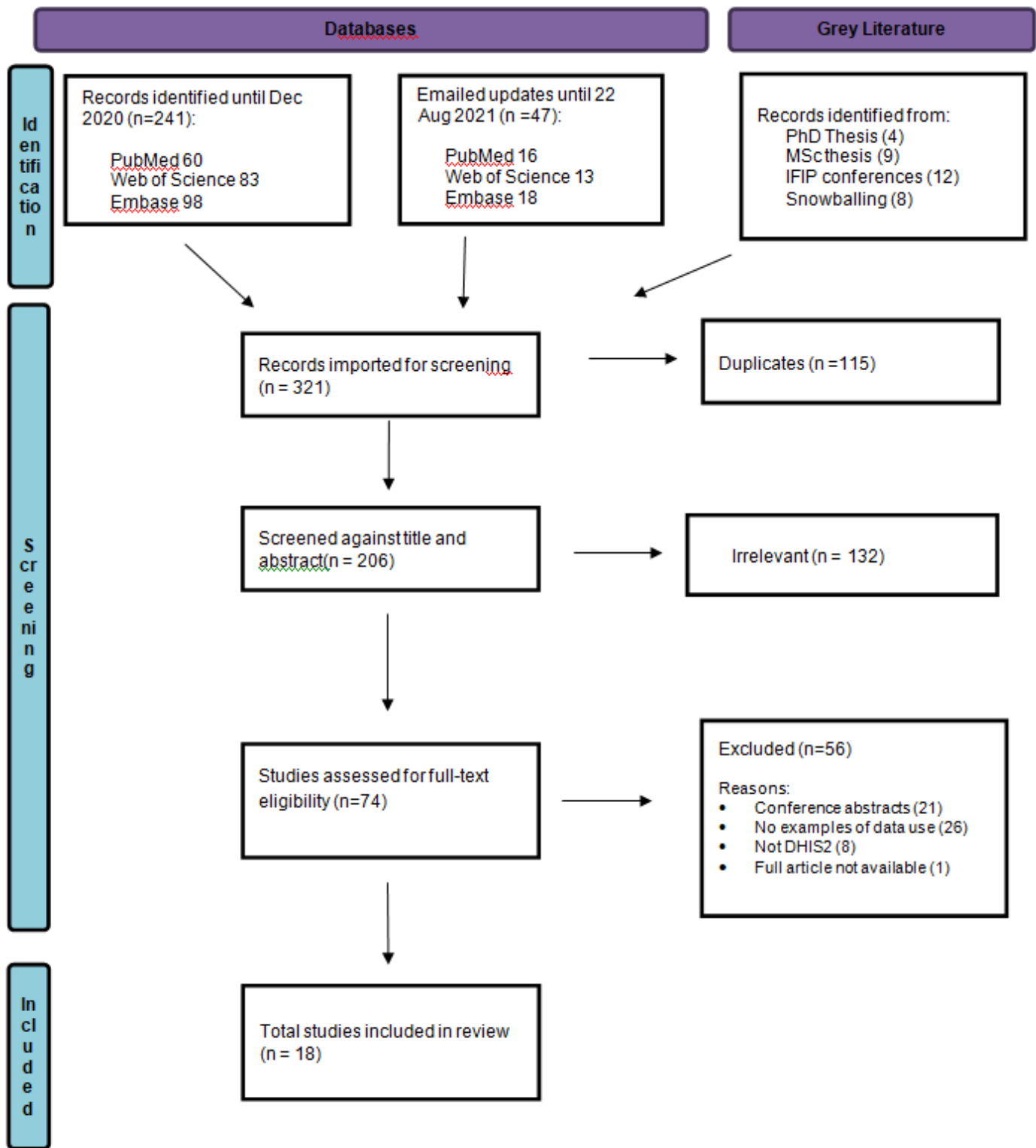
Figures

Figure 1

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) for the scoping review

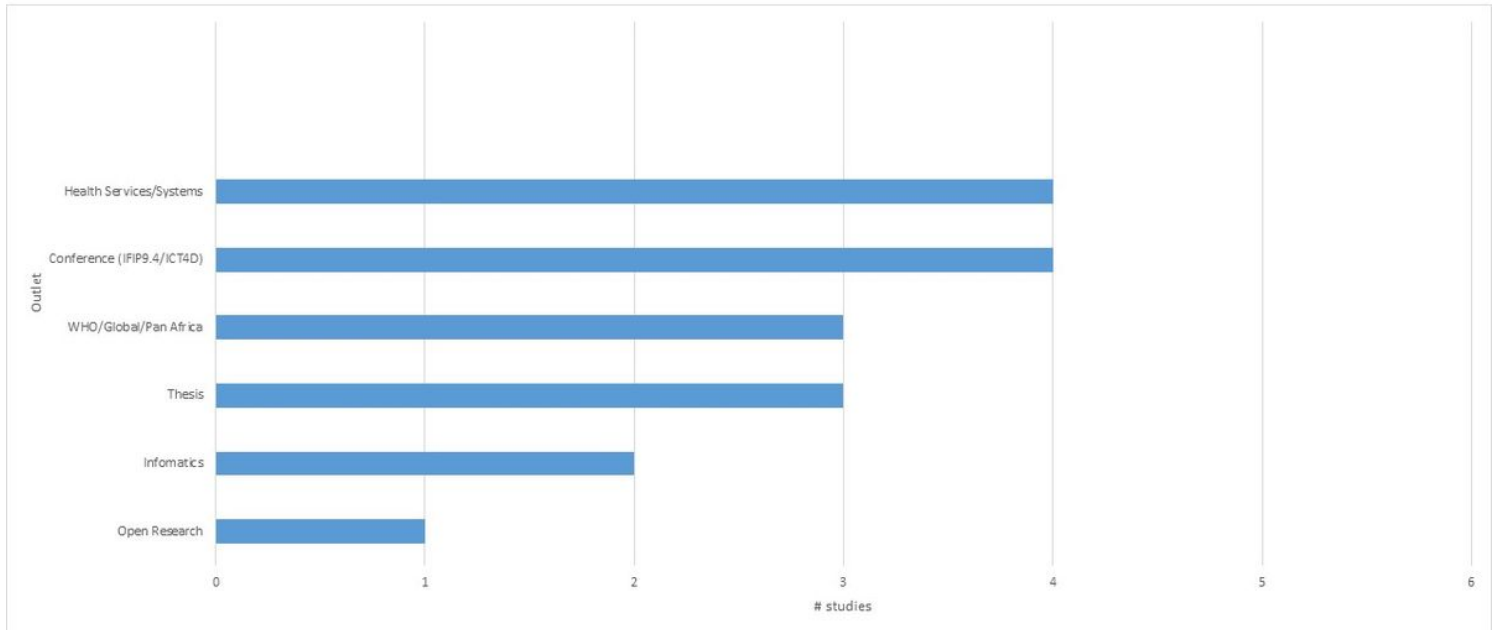## Figure 2: Publication outlets for texts included

Figure 2

Interestingly only 2 of the articles were in informatics journals perhaps indicating the focus on the design, implementation and analytics in these journals and not actions taken or decisions made based on the data collected (see Figure 2).
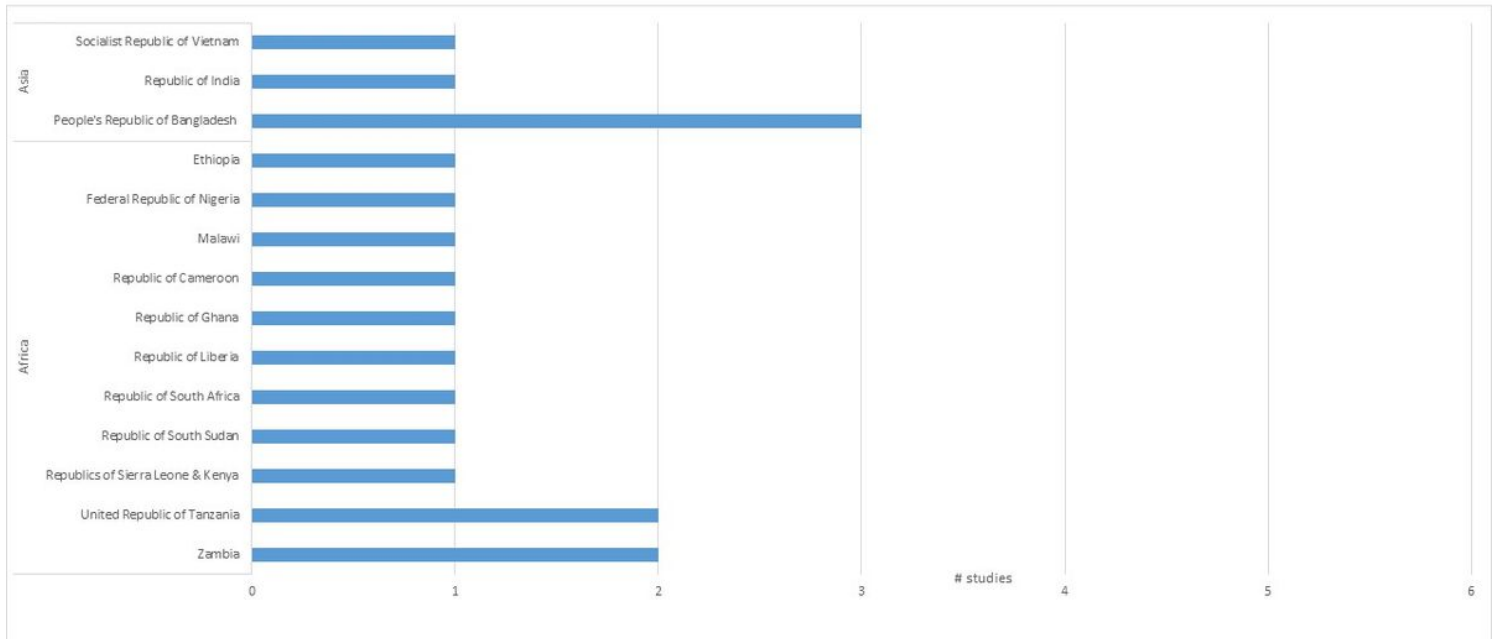
Figure 3: Geographic focus of studies

Figure 3

The included studies were predominantly from Africa (with one comparing two African countries) and the remaining studies conducted in Asia. This is not surprising given that it is in these two regions that DHIS2 has been primarily adopted as the routine HMIS (see Figure 3).
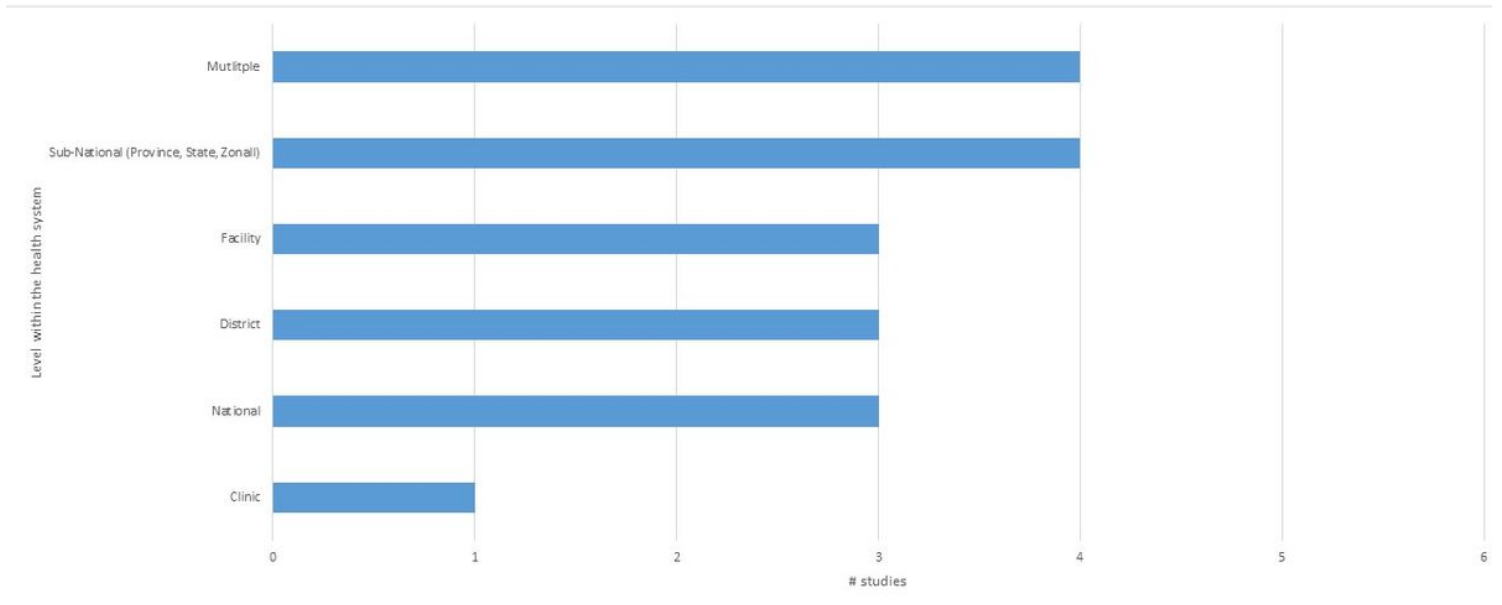
Figure 4: Level within the health system

Figure 4

There was a variety of levels within the health system that were investigated, though national level, one level below national (indicated as sub-national) and multi-level studies formed the majority of studies (see Figure 4).

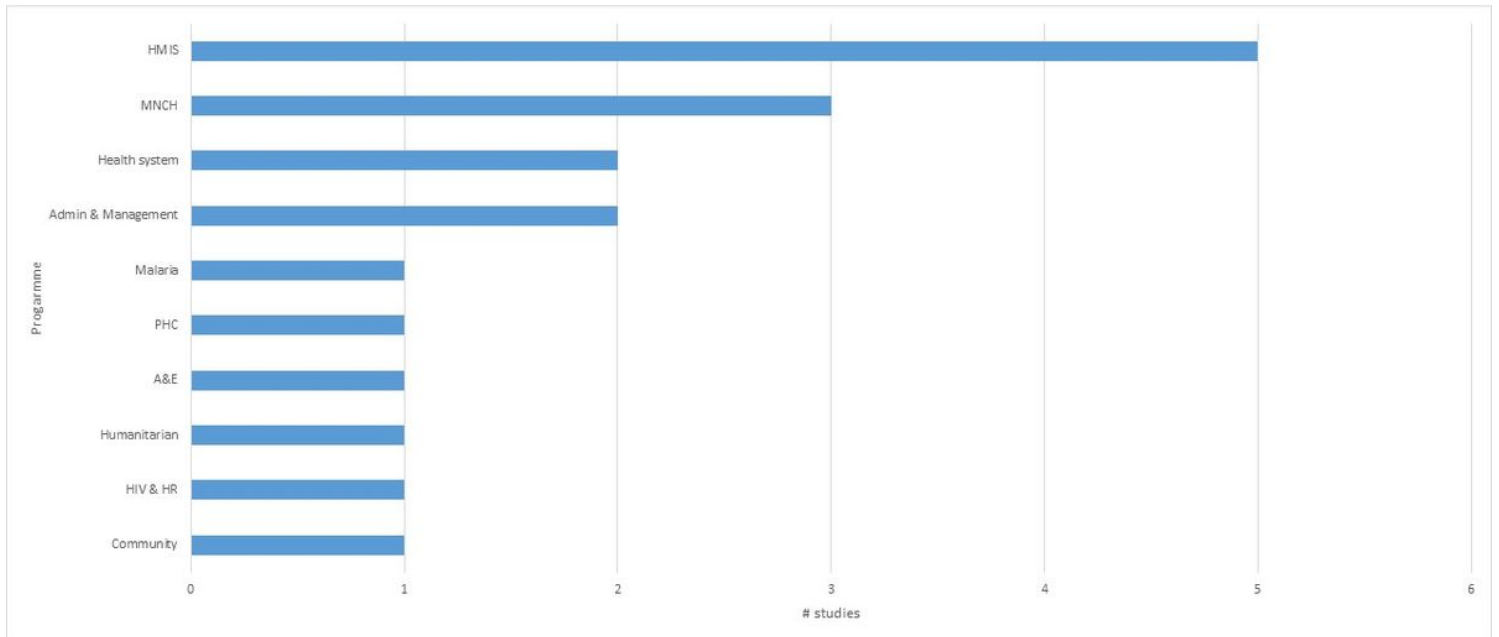Figure 5: Programmatic focus of study

Figure 5

Different programmatic areas were investigated though most of the studies focused on the HMIS rather than a specific programmatic area, with Maternal, neonatal and child health and Malaria being the most common programmes reviewed (see Figure 5).
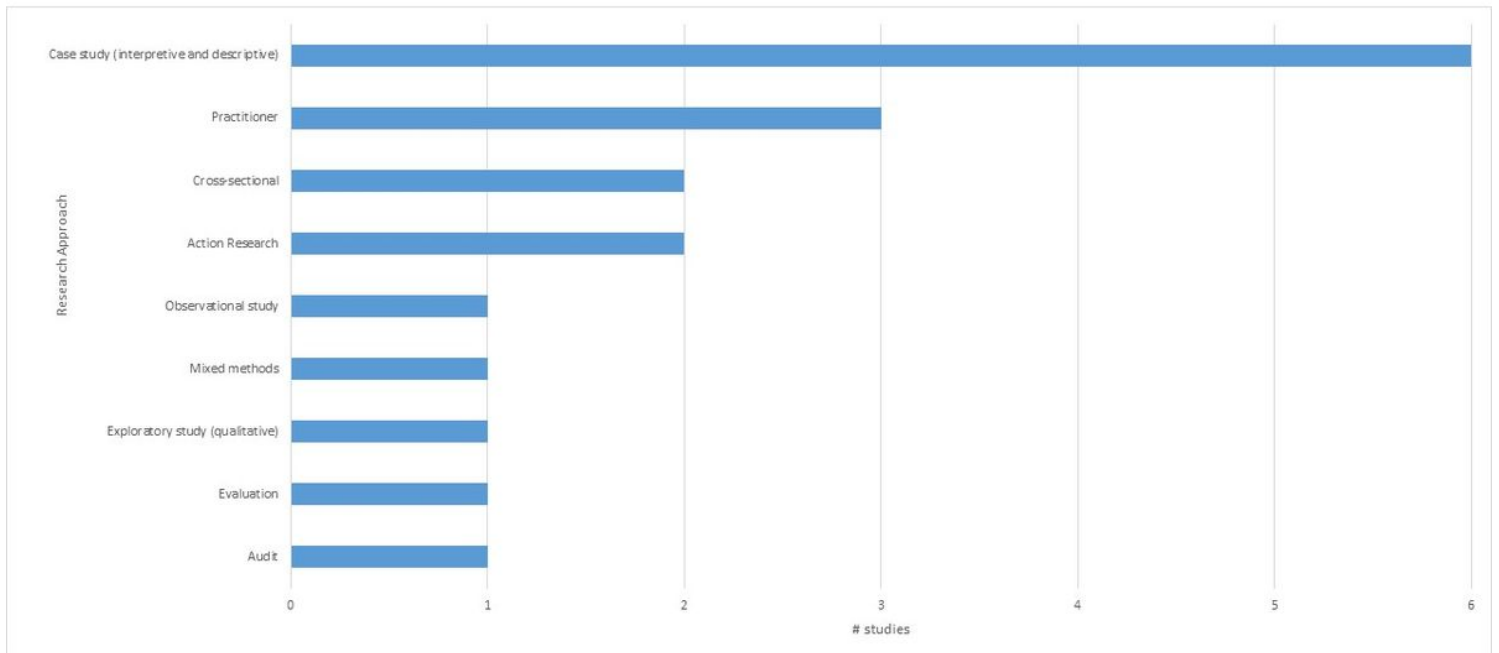
Figure 6: Type of study

Figure 6

Case studies were the most common study though there were quite a variety of study types as well as a mix of quantitative and qualitative data collection methods used (see Figure 6).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- APPENDIX1.docx