BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (http://bmjopen.bmj.com).

If you have any questions on BMJ Open's open peer review process please email

info.bmjopen@bmj.com

BMJ Open

Benefit cost analysis of electronic claims processing under Ghana's National Health Insurance Scheme

SCHOLARONE™
Manuscripts

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

Benefit cost analysis of electronic claims processing under Ghana's National Health Insurance Scheme

Justice Nonvignon[1]*, Rebecca Addo[2], Huihui Wang[3], Anthony Seddoh[4]

[1]Department of Health Policy, Planning and Management, School of Public Health, College of Health Sciences, University of Ghana, P. O. Box LG13, Legon, Ghana
[2]Centre for Health Economics Research and Evaluation (CHERE), University of Technology Sydney, Australia
[3]The World Bank Group, Ghana, Accra, Ghana
[4]The World Bank Group, Washington, D.C, United States of America

*Corresponding author's email address: jnonvignon@ug.edu.gh

ABSTRACT

Objective: The aim of this study was to evaluate the benefit-cost of E-claims. A benefit-cost analysis was used to evaluate the efficiency of E-claims from the perspective of the providers and the purchaser.

Design: A benefit-cost analysis approach was taken for this economic evaluation. Further, we estimated the incremental benefit-cost ratio (IBCR) of the intervention under assessment.

Participants: Purchasers and healthcare providers of the NHIS of Ghana were the study population

Results: The analysis was stratified according to providers and purchaser. Cost incurred in processing claims electronically and manually were estimated by assessing the resource use and their corresponding costs. Sensitivity analysis was conducted to assess the robustness of the results to variations in discount rate and proportions of claims processed under E-claims compared to paper claims. The combined sample of providers and purchaser made incremental gains from processing claims electronically. The IBCR was -19.75, 25.56 and 5.10 for all (sample) providers, purchaser and both providers and purchaser, respectively. When projected for the 330 facilities submitting claims to the NHIS CPC as at December 2014, the IBCR were -35.20, 25.56 and 90.06 for all providers, purchaser and both providers and purchaser. The results were sensitive to the discount rate used and proportions of E-claims compared to paper claims.

Conclusion: Electronic processing of claims is more efficient compared to manual processing, hence provide an economic case for scaling it up to cover many more healthcare facilities and NHIS CPCs in the Ghana.

Keywords: cost-benefit analysis, electronic claims processing, national health insurance scheme, Ghana

Strengths and limitations of this study

- There are difficulties in quantifying some of the benefits of the E-claims into monetary terms. Thus, methodological challenges with cost-benefit analysis hinder the use of some of the benefits in a cost-benefit analysis.

- Possibility of under-estimation of the IBCRs reported in this study with the exclusion of such key benefits of electronic claims processing.

- There is little evidence available regarding the use of electronic claims processing that provides a comparison to Ghana's, therefore, it was difficult to identify similar studies

- The study provides strong evidence on the scaling up of the E-claims system which improves the efficiency of the NHIS increasing their benefits compared to the manual processing of claims

- This study addressed important gaps in knowledge about electronic claims processing and manual processing of insurance claims in a resource-constraint setting.

BACKGROUND

Prior to the establishment of Ghana's National Health Insurance Scheme (NHIS) in 2003, the health financing system in Ghana was characterized by high out-of-pocket (OOP) payment at the point of service, low private health insurance penetration and few community-based health insurance schemes (CBHIS). Previous studies have provided a comprehensive historical overview of health financing in Ghana [1], and other contexts of the NHIS [2-4]. Other studies explored provider payment mechanisms and sustainability of expenditure under the NHIS [5-11].

The main objective of the NHIS as contained in the Act 650 establishing it (and later Act 852 2012) was "to secure the provision of basic healthcare services to persons resident in the country" [12]. The NHIS is mainly financed by value-added tax and Social Security National Insurance Trust (SSNIT) deductions, covering 95% of the disease conditions afflicting the population. A Free Maternal and Child Care policy was also introduced in 2008 with support from the British Government [8] to accelerate attainment of MDG 4 and 5, under which antenatal, delivery and post-natal care services to pregnant women were made free to clients [5]. Faced with a number of issues around governance and operations, legalities and definition of exempt groups, the National Health Insurance Act, 2012 (Act 852) was passed in 2012 [12] replacing Act 650. By the end of 2014, the NHIS had a total active membership of 10,545,428 representing 39% of the total population of Ghana [13].

Since its implementation in 2004, the NHIA, the regulator of the NHIS, has used various provider payment mechanisms (PPMs) to reimburse health service providers for use of services by NHIS members. At the start of the implementation in 2004, itemized billing with no standard fee schedule was used to reimburse providers for services and medicines. Under this PPM, providers negotiated reimbursement rates with the NHIS office at the district level. In 2008, the Ghana-Diagnostic Related Grouping (G-DRG) payment mechanism was introduced to address challenges such as the inability of healthcare providers to code claims properly (resulting in the submission of incomplete claims); escalating costs due to spurious claims; and the lack of a system to monitor fraud. The G-DRG was used to pay for services and procedures while payment for medicines was made using standardized itemized fees (fee-for-service) based on a medicines list [5 7]. Under the G-DRG payment system, facilities submit claim forms filled for each outpatient visit and inpatient episode (coded under G-DRG) to NHIS for reimbursement. In addition, due to continued cost escalation, some of which has been attributed to fraud and moral hazards [14], per capita (capitation) payment mechanism for primary health care services was introduced in 2012. This was piloted in the Ashanti region [5 7] and was scaled up to two additional regions but was halted in 2017.

In the search of a more efficient method of reimbursing providers while financially sustaining the NHIS, the electronic claims (E-claims) processing was introduced in 2013 [11]. This initiative was part of the World Bank-supported health Insurance Project (HIP) whose main objective was to create an enabling environment for the scheme and facilitate its financial and operations management. The E-claims processing was piloted in 29 health facilities (providers) by the end of the project in March 2014. In 2019, the E-claims covered 120 healthcare facilities across the country and received a quarter of total volumes of claims submitted to National Health Insurance Authority (NHIA), the purchaser.

To demonstrate the effectiveness of E-claims over paper claims processing, [9], used a cross-sectional study to compare the ability of E-claims and paper claims processing to detect spurious claims and reduce costs to the NHIA. The authors found that the E-claims review system had the ability to reduce cost to the NHIA more than

paper claims (17% vs 4.9%). While this study demonstrates that E-claims is effective in reducing cost to the NHIA compared to paper claims processing, the costs and benefits of processing claims electronically or manually to providers and the overall health system is not known. A comprehensive economic evaluation could contribute to informed decision on which claims processing type provides value-for-money to both providers and the overall health system. Therefore, the aim of this study was to assess the costs and benefits of E-claims compared to the paper claims processing to inform policy makers, as well as fill a gap in the literature.

METHODS

Study design

A benefit-cost analysis approach was taken for this economic evaluation. BCA assesses the costs and benefits of an intervention compared to the next best alternative. Unlike other types of evaluations, BCA assesses the monetary value of the benefits. Its theoretical foundations are from the concept of Pareto efficiency, where an additional re-allocation is acceptable only if it makes at least one person better off without making another person worse off. In this study, we estimate the incremental benefit-cost ratio (IBCR) of the intervention under assessment. The IBCR in a BCA denotes the net benefit of an intervention compared to its best alternative. Therefore, using BCA, an intervention is said to be efficient compared to the next best alternative if the net benefit is positive.

Thus, this study sought to assess the efficiency of the E-claims compared to paper-claims system, and to establish if the marginal benefits of processing claims electronically at least covers its marginal cost: implying positive net benefits, or not. We report our methods and results in accordance with the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) [15].

Study population

Purchasers and healthcare providers of the NHIS of Ghana were the study population. The purchaser selected was the claims processing centre (CPC) of the NHIS. For the purposes of this evaluation, 11 providers were purposively sampled; four districts and five regional hospitals who were processing their claims electronically were selected based on the start dates of the E-claims system (i.e. we selected facilities that had processed E-claims for at least one year prior to evaluation); the Police hospital and the 37 Military hospital were also selected based on their experience with implementing the E- claims. Therefore, in addition to estimating the overall net benefit of E-claims processing in Ghana, the analysis was further categorised into the following subgroups; district, regional, tertiary and central processing centre.

Perspective of analysis

The evaluation was conducted from the perspective of the Ghana health system to establish whether it was worthwhile for the system to invest in the E-claims by extending its coverage to all providers and NHIS processing centres.

The claims processing system

The evaluation compared the costs and benefits of E-claims system which simplifies claims submission and helps automate claims vetting process, and Paper-claims system that entails a completely manual claims submission and vetting process.

Under E-claims system, providers may submit claims through two options: 1) an XML (Extensible Markup Language) interface that transmits claim information from the provider's HMIS and electronic health record system (EHRS), and 2) Web-based tool for entering and submitting claim information. These claims are submitted to the purchaser, the NHIA' CPC in Accra, where they are equipped to electronically vet and process the E-claims submitted by providers. Under Paper-claims system, on the other hand, providers fill out claims forms per patient and submit all the forms compiled over a period to the purchaser for reimbursement.

In terms of claims processing, both E-claims and Paper-claims systems follow the same steps to process claims for reimbursement. For instance, at the purchaser side, once the CPC receives claims from the providers, they confirm the volume and value of the claims received. Afterwards, the claims are vetted to assess providers' adherence to eligibility, benefit package, Ministry of Health (MOH) treatment protocols, diagnosis, prescribing levels, treatment and tariffs assigned to each claim. Any deviation from the NHIS requirements are accounted for by adjusting claims submitted, after which reports are written and submitted to the providers and the Chief Executive Officer of the NHIA. The difference between the electronic and manual claims is that whereas the processing steps outlined above are automated either fully or partially under the former, the later are carried out manually. At the provider's side, once they submit the claims to the CPC either electronically or by claim forms, data are entered for the manual claims, but the remaining steps carried out by the CPC as described above. Figure 1 presents the steps involved in processing claims under the NHIS.

Both processes require labour capacity to undertake entry of data into the web-interface for the E-claims and filling and compiling of forms under the manual claims. In addition to this, a provider requires a computer, UPS, sustained internet connection, staff with the appropriate skills and electricity to submit E-claims.

[Figure 1]

Estimating costs

Data on resource use and their associated costs were obtained from the NHIA and providers under study. At the providers' side, annual cost data were collected – year 2012 for costs involved in processing paper claims (all facilities under study were using paper claims) and year 2014 for costs involved in E-claims processing (all

facilities under study had rolled out E-claims processing fully). At the purchaser side, data was collected for only year 2014 for both the costs of processing paper claims and E-claims. This was because at the time, the CPC was processing both types of claims since not all providers had been enrolled onto the E-claims system. However, the cost data collected were disaggregated into paper and electronic claims by weighting the total claims by the proportions of E-claims and paper claims processed during 2014.

The costs information collected included capital and recurrent costs. Capital costs included the costs of installation (server and software purchase/upgrade, internet) and equipment (printers, computers, air conditioner, routers, and inverter). Recurrent costs included labour, transport, staff training, operations costs (office space/storage space rental costs, furniture) electricity bills, and stationery.

The total capital costs incurred by the providers were calculated by summing the costs attributable to each capital cost item. Further, since the start-up costs for the E-claims reflect costs of inputs spanning over more than one year, the equivalent annual cost (EAC) of capital items was derived by dividing the total capital cost (summed for all units of a given capital item) by the annualization factor. This was done to enable summation of capital costs with recurrent costs that occurred within one year. The annualization factor was derived from annuity tables using the useful life of each capital item (3 years were assigned for printers, UPS, stabilizer, router and batteries; and 5 years were assigned for other capital items including computer based on discussions with providers) and a discount rate of 3%. Thus, the total capital cost (for E-Claims and paper claims) for a provider was derived by summing the EACs for all capital inputs.

The total cost incurred by the provider for each recurrent item was also calculated by multiplying the unit costs by quantity. Total recurrent cost was calculated by summing the recurrent costs that providers attributed to recurrent items they used in processing both E-Claims and paper claims. Data on the number of staff under each staff category involved in processing claims (E-Claims and paper claims) for each provider together with the proportion of time that each staff spends per month on claims processing and the gross monthly salary of each staff were collected. The labour cost per staff attributable to claim processing was calculated by multiplying the total monthly gross salary by the proportion of time spent. This was summed over one year and across staff categories to derive the total labour costs, which were then added to the recurrent costs. The costs of the paper claims were converted into 2014 estimates: base year of analysis, using the consumer price indices (CPIs) for health goods collected from the Ghana Statistical Service [16]. The total costs per providers were estimated by summing capital and recurrent costs. Cost per claim processed under each type of claims processing were derived by dividing the total costs by the total number of claims processed.

From the purchaser's side, the total operational costs (i.e. excluding capital and other investment costs) of the NHIA for 2014 was collected and used to apportion operational costs to the CPC based on the proportion of staff in the CPC as compared with the total number of staff of NHIA. The assumption here is that the proportion of staff reflects the proportion of not only staff time but also other operational expenses that could be attributed to the activities of the CPC. This was done as it was difficult to disaggregate specific cost items for the CPC. Once the operational costs attributable to CPC was derived, the proportion of E-Claims or paper claims processed by the CPC was used to apportion the CPC operational costs to either E-Claims or paper claims. Then, the cost per claim was derived by dividing the total costs of E-Claims/paper claims by the total volume/number of such claims processed by the CPC. The cost analysis was performed in Ghana Cedis (GHS) and converted into United States Dollars (US$) using the US$-GHS exchange rate for June 30, 2014 (3.00) accessed from www.xe.com.

Estimating benefits

The benefits of claims were assessed using: 1) volumes and values of claims reimbursed and 2) claims rejection rate. For the providers, the volumes of claims were the total number of claims submitted for reimbursement. Subsequently, the values of the claims were estimated as their expected payout from the NHIS. Claims rejection rate was estimated as the difference between the claims submitted for reimbursement and the actual number of claims that were reimbursed by the NHIS. In other words, the difference between the projected value claims submitted and the actual payout received from the NHIS. The claims rejection rate was estimated for each month and that for the one-year period estimated as the average rejection rate per month for year 2012 and 2014 for paper claims and E-claims respectively.

Therefore, benefits of E-claims and paper claims per provider was estimated as the difference between the value of the submitted claims and the value of claims reimbursed (accounting for claims rejection rate). The value per claim submitted per provider was calculated by dividing the total value of claims submitted by the total volume of claims submitted.

On the other hand, the benefits of either types of claims processing to the purchaser (NHIA CPC) was estimated as the costs saved from the payouts that were not made due to rejection of submitted claims from providers. Thus, they were calculated as the cost due to rejected claims; that is, the difference between the expected payout for claims submitted by providers and the actual payout made after adjusting for claims rejected.

Estimating incremental benefit-cost ratios

Incremental costs were calculated as a difference between the cost of E-claims and paper claims. The incremental benefits were calculated as the difference between the benefits of the E-claims and paper claims (Table 1). The incremental benefit-cost ratios (IBCRs), a measure of efficiency, were therefore estimated for each provider and CPC (or purchaser) by dividing incremental benefits ($B_{E-claims}-B_{paper\ claims}$) by incremental costs ($C_{E-claims}-C_{paper\ claims}$). The IBCR per specific unit (that is provider or purchaser) determines the efficiency of that unit. An IBCR greater than 1 indicates that the additional benefits of E-claims outweigh the additional costs. The IBCR was calculated for each provider, provider type (i.e. district/regional/teaching hospital), purchaser and the entire health system (that is, both providers and purchaser). The analysis for provider type used the average costs and benefits of each provider type (i.e. summing for all units in the specific provider type within the study sample and dividing by the number of units). The analysis for the health system was done by adding the costs and benefits of all providers and purchaser and estimating their IBCR.

Furthermore, the analysis was extended to cover total number of providers (by type) projected to submit claims to the CPC as at December 2014 (i.e. 330 primary/district level, eight secondary/regional level, one tertiary providers), accessed from the NHIA. It is worthy to note that 91% of these facilities were not processing their claims electronically at the time of data collection. The costs and benefits were calculated by multiplying the average costs and benefits of providers (according to type) to the total number of providers using E-claims at the time of evaluation. There was only one E-claims processing centre for the NHIA as at 2014.

Table 1: Detailed calculation formulas

Estimating costs

Provider	
Total costs	Total Recurrent costs + Total capital costs
Capital costs	Sum of equivalent annual cost of capital
Equivalent annual capital cost	Current cost of capital / annualization factor
Recurrent cost	Unit cost * quantity for each item
Purchaser	
Total operational cost of CPC	Total operational cost of NHIA * proportion of CPC staff to total staff
Operational cost of e-Claims or Paper claims	Total CPC operational cost * proportion of staff processing e-claims or paper claims
Estimating benefits	
Provider	
Benefits of e-Claims or paper claims	Total value of submitted – total value of reimbursed claims
Purchaser *Cost savings*	Expected payouts from submitted claims – actual payout/reimbursement
Incremental benefit-cost ratio	
Incremental cost	Total cost of e-claims – Total cost of paper claims
Incremental benefit	Total benefit of e-claims – Total benefit of paper claims
IBCR	Incremental benefit / incremental cost

Sensitivity analysis

Some key parameters of the study were varied to ascertain the robustness of the IBCRs estimates. A univariate sensitivity analysis was conducted on the discount rate and the proportions of claims processed under E-claims compared to paper claims.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting or dissemination plans of our research.

RESULTS

Costs of processing E-claims and Paper claims

Table 2 presents the costs per claim for the two processing types for the study population: providers and purchaser. The average cost per E-claim for the providers was US$0.65, US$0.93 and US$1.95 for the district,

regional and tertiary hospitals respectively. The providers also incurred an average cost per paper claim of US$0.30, US$1.16, and US$2.26 for the district, regional and tertiary hospitals respectively. The total cost per claim for all providers was US$10.18 and US$10.45 for E-claims and paper claims respectively. Among the providers, the cost of processing[1] both electronic and paper claims were highest among tertiary hospitals. In addition, Volta regional hospital spent the highest cost in processing E-claims followed by La General Hospital. Conversely, Atebubu hospital incurred the least cost in processing E-claims. In processing paper claims, Volta regional hospital incurred the highest cost followed 37 Military hospital. Takoradi hospital spent the least in processing paper claims. The purchaser; NHIS CPC incurred US$0.59 for processing each E-claim and US$0.50 for processing each paper claim at the CPC.

Recurrent costs accounted for a higher percentage of the costs of processing both E-claims and paper claims for providers and purchasers alike. For example, for district hospitals recurrent costs constituted 86% of E-claims processing costs and 96% of paper claims processing costs (see additional file for detailed description). The main driver of the recurrent cost was labour, followed by maintenance. It is worthy to note that start-up cost of E-claims contributed to 13.6%, 8.7%, 8.3% of the overall costs for district, regional and tertiary hospitals respectively. Cost of labour also accounted for 50-76% of costs of E-claims and 59-83% of costs of paper claims.

---

[1] The cost of processing claims includes all costs incurred from preparing and submitting claims

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Table 2: Estimated costs of processing E-claims and paper claims by healthcare providers and purchaser, 2014

Study population	Cost per claim (US$)	
	E-claims	**Paper claims**
Providers		
District		
Atebubu hospital	0.27	0.22
St. Martins hospital	0.59	0.29
Takoradi hospital	0.29	0.12
La general hospital	1.46	0.57
Average District	*0.65*	*0.30*
Total district	*2.61*	*1.2*
Regional		
Sunyani hospital	0.90	0.29
Koforidua hospital	0.61	1.25
Ridge hospital	0.81	0.32
Police hospital	0.74	1.95
Volta hospital	2.00	2.60
Effia Nkwanta hospital	0.56	0.58
Average Region	*0.94*	*1.17*
Total region	*5.62*	*6.99*
Tertiary		
37 Military hospital	1.95	2.26
All providers		
Average	0.93	0.95
Total	10.18	10.45
Purchaser		
CPC	0.59	0.50
Health system (All providers and Purchaser)		
Average	0.90	0.91
Total	10.77	10.95

Note:

All costs were estimated in 2014. A conversion rate of GHC3.00 per US$1 was used.

Abbreviation: CPC; claims processing centre, E-claims; electronic claims

Benefits of processing E-claims and paper claims

Table 3 presents the benefits of E-claims and paper claims to the healthcare providers and the purchaser (NHIA). The average value per E-claim without errors (that is expected payout) for the providers was US$9.29, US$14.96 and US$114.31 for the district, regional and tertiary hospitals respectively. The average value per paper claim without errors was US$8.22, US$13.87 and US$18.26 for the district, regional and tertiary hospitals

respectively. When put together, all providers were expected to gain US$128.31 per E-claim and US$125.52 per paper claim as claims payout.

The NHIA expected payout for processing claims electronically and manually were US$11.26 and US$9.71 per claim respectively. However, after correcting for errors, they paid out US$11.03 per E-claim submitted and US$ 8.74 per paper claim submitted by providers, hence making a cost savings (benefits) of US$ 0.23 and US$ 0.97 for each electronic and paper claim submitted by providers respectively.

The average rejection rates for E-claims versus paper claims were 3% (0.001% - 10%) vs 10% for the district hospitals, 1% vs 6 for regional hospitals, 0% vs. 6% for tertiary hospital, 2% vs 10% NHIA respectively. The highest rejection rate was seen among paper processing of claims for both providers and purchaser.

Table 3: Estimated benefits of E-claims and Paper claims by providers and purchaser, 2014

Study population	Value per claim submitted		Rejection rate (%)		Value per claim reimbursed (US$) (accounting for rejection rate)	
	E-claims	Paper claims	E-claims	Paper claims	E-claims	Paper claims
Providers						
District						
Atebubu hospital	9.06	8.82	10.00	20.00	8.16	7.05
St. Martins hospital	9.81	12.42	0.00	5.00	9.81	11.80
Takoradi hospital	9.07	4.65	0.10	0.10	9.06	4.64
La general hospital	10.15	9.67	0.00	3.00	10.15	9.38
Average District	*9.52*	*8.89*	-	-	*9.29*	*8.22*
Total district	*38.08*	*35.55*	-	-	*37.17*	*32.87*
Regional	0.00	0.00				
Sunyani hospital	15.94	14.51	2.40	3.00	15.56	14.08
Koforidua hospital	16.62	15.13	-	12.50	16.62	13.24
Ridge hospital	17.06	14.21	0.30	3.00	17.01	13.78
Police hospital	12.58	14.53	0.50	15.00	12.52	12.35
Volta hospital	12.98	16.44	-	0.00	12.98	16.44
Effia Nkwanta hospital	15.05	15.15	0.60	12.00	14.96	13.33
Average Region	*15.04*	*15.00*	-	-	*14.96*	*13.87*
Total region	*90.23*	*89.97*	-	-	*89.64*	*83.22*
Tertiary						
37 Military hospital	14.31	19.48	-	6.30	14.31	18.26
All providers						
Average	11.66	11.41	-	-	11.55	10.50

Study population	Value per claim submitted		Rejection rate (%)		Value per claim reimbursed (US$) (accounting for rejection rate)	
	E-claims	Paper claims	E-claims	Paper claims	E-claims	Paper claims
Total	128.31	125.52	-	-	126.81	116.09
Purchaser						
CPC (NHIA)	11.26	9.71	2.00	10.00	0.23	0.97
Health system (All providers and purchaser)						
Average	11.63	11.27	-	-	10.59	9.76
Total	139.58	135.23	-	-	127.04	117.07

Note: All costs were estimated in 2014. A conversion rate of GHC3.00 per US$1 was used.

Abbreviation: CPC; claims processing centre, E-claims; electronic claims

Incremental benefit cost ratio of processing E-claims and paper claims

Table 4 presents a summary of the incremental benefit-cost ratios (IBCRs) by study population (study units). The incremental cost for all providers was estimated at US$-0.27 and that for the purchaser (CPC of the NHIA) was US$0.09. When stratified by types of providers, the average incremental cost per E-claim per district, regional and tertiary hospitals were US$0.35, US$-0.23, and US$-0.31 respectively. The average incremental benefits per E-claim were US$1.07 for district hospitals, US$1.07 for regional hospitals, US$-3.94 for tertiary hospital and US$-0.75 for CPC. Overall, the incremental benefit for all providers was estimated at US$10.72 and purchaser and providers was US$ 9.97 per E-claim.

The IBCR was 3.05 for district hospitals, -4.69 for regional hospitals, 12.72 for tertiary hospital and -8.28 for CPC. Two out of four district hospitals recorded IBCRs of less than one: St Martin's hospital (-6.65) and La general hospital (0.86). Three regional hospital also had an IBCR of less than one: Koforidua regional hospital (-5.28), Police hospital (-0.14) and Efia Nkwanta regional hospital (-81.49). The overall IBCR for all providers was -25.09 and that for the health system was -33.49.

Table 4: Incremental benefit-cost ratio of processing E-claims and paper claims by healthcare providers and purchaser, 2014

Study population	Incremental cost (US$)	Incremental benefits (US$)	IBCR
Providers			
District			
Atebubu hospital	0.05	1.10	22.07
St. Martins hospital	0.3	(1.99)	(6.65)
Takoradi hospital	0.17	4.42	25.97
La general hospital	0.89	0.77	0.86
Average District	*0.35*	*1.07*	*3.05*

Study population	Incremental cost (US$)	Incremental benefits (US$)	IBCR
Total district	*1.41*	*4.29*	*3.05*
Regional			
Sunyani hospital	0.61	1.48	2.43
Koforidua hospital	(0.64)	3.38	(5.28)
Ridge hospital	0.49	3.22	6.58
Police hospital	(1.21)	0.17	(0.14)
Volta hospital	(0.60)	-3.46	5.77
Effia nkwanta hospital	(0.02)	1.63	(81.49)
Average Region	*(0.23)*	*1.07*	*(4.69)*
Total region	*(1.37)*	*6.42*	*(4.69)*
Tertiary			
37 Military hospital	(0.31)	(3.94)	12.72
All providers			
Average	(0.02)	0.97	(48.71)
Total	(0.27)	6.77	(25.09)
Purchaser			
CPC (NHIA)	0.09	(0.75)	(8.28)
Health system (All providers and purchaser)			
Average	(0.01)	0.83	(83.09)
Total	(0.18)	6.03	(33.49)

Note:

All costs were estimated in 2014. A conversion rate of GHC3.00 per US$1 was used.

Abbreviation: CPC; claims processing centre, E-claims; electronic claims

Values in parenthesis denote negative values

Table 5 further presents the IBCR of all providers nationwide submitting claims to the NHIS CPC as at the end of 2014. The IBCR extrapolated for providers and purchaser nationwide were 3.05 for district hospitals, -4.69 for regional hospitals, 12.72 for tertiary hospitals and -8.28 for the CPC. IBCR for all providers nationwide was 11.08 and the entire health system was 2.79.

Table 5: Extrapolated IBCR for all providers submitting claims to the NHIA CPC as at the end of year 2014

Study population	Incremental cost (US$)	Incremental benefits (US$)	IBCR
^Providers			
All district hospitals	347.98	1706.80	4.90
All regional hospitals	(231.64)	764.98	(3.30)
Tertiary hospitals	(307.18)	(3953.13)	12.87
All providers	*(63.61)*	*2239.18*	*(35.20)*
Purchaser			

Study population	Incremental cost (US$)	Incremental benefits (US$)	IBCR
CPC	89.97	2300.02	25.56
Health system			
All providers and purchaser	26.36	2373.95	90.06

^Providers submitting claims to CPC by end 2014; All costs and benefits were estimated in 2014. A conversion rate of GHC3.00 per US$1 was used; Values in parenthesis denote negative values

Study population	Incremental cost (US$)	Incremental benefits (US$)	IBCR
***Providers**			
All district hospitals	116.33	354.31	3.05
All regional hospitals	(1.83)	8.56	(4.69)
Tertiary hospitals	(0.31)	(3.94)	12.72
All providers			
Average	(91.53)	3633.04	(39.69)
Total	***114.19***	***358.93***	***11.08***
Purchaser			
CPC	0.09	(0.75)	(8.28)
Health system (All providers and purchaser)			
Average	(3.4)	282.52	(83.09)
Total	***114.28***	***358.18***	***2.79***

*All providers nationwide; All costs and benefits were estimated in 2014; A conversion rate of GHC3.00 per US$1 was used; Values in parenthesis denote negative values; As at the period of data collection, there were 330 districts hospitals, eight regional hospitals, one tertiary hospital and one NHIS CPC using E-claims processing

3.4 Sensitivity analysis

The results of the sensitivity analysis showed that increasing the discount rate for both costs and benefits led to reductions in the IBCRs for each study unit and vice versa. However, this change did not influence the direction of the findings: from being efficient to not efficient and vice versa. For example, a 10% discount rate did not change the claims processing of a provider or purchaser from being profitable to unprofitable. When the proportions of E-claims to total claims were increased, the IBCR of the NHIA CPC reduced. For instance, increasing the proportion of E-Claims from the base of 29% to 50% as against 50% paper claims (from 71% at base) reduced the IBCR from 15.14 to 2.32. The analysis shows that if all claims were processed electronically, 100% the IBCR will be less than one (0.76), indicating that the incremental cost of processing additional claims exceeds incremental benefits. The CPC of NHIS can only achieve IBCR of one when 81% of claims are processed electronically and 19% processed manually. Any higher proportion of E-Claims worsens the IBCR.

DISCUSSION

Analysis of the benefits and costs of the E-claims and paper claims processing systems of the NHIA show that electronic processing of clams is more efficient than the manual system. On the average, all providers spent less cost in processing E-claims compared to paper claims. However, contrary to what was expected, the E-claims was more labour intensive. This could be attributed to providers associating efficiency of claims processing to the number of staff assigned to it: the higher the number of staff, the more efficient the processing and vice versa. Therefore, a more cost saving approach in terms of less labour under the E-claims could improve the efficiency gains by reducing the costs of processing. On the other hand, the purchaser (NHIA) spent more money to process claims electronically compared to manual system. The reason for this is not readily known but might be due to maintenance cost of the E-claims infrastructure. The E-claims set-up requires periodic repairs and upgrade by the service provide to make it more robust and efficient, and this comes with cost to the NHIA. Generally, the healthcare providers and the purchaser (NHIA) benefit more from processing claims using the electronic system than manual one. This assertion stems from the higher rejection rates from the E-claims processing system, compared to the paper claims processing system: 7.26% versus 1.26% for all providers and 10% versus 2% for the NHIS. These findings confirm the study by Nsiah-Boateng et al., which reported that the E-claims processing system has a higher claims rejection rate than the paper claims processing system, and concluded that the former could reduce cost to the NHIS. However, the claims rejection rates reported by our study were different from that reported by Nsiah-Boateng et al [9]. For example, while they reported an adjustment rate of 17.9% for district hospitals using E-claims, we estimated 10% claims rejection rate for district hospitals. The difference in the rejection rate size could be attributed to the different methodological approaches employed to estimate effectiveness of E-claims processing system, the number and type of facilities used for both studies, and the study period.

This study also reveals a reduction in the volumes of claims submitted by providers under the E-claims compared to the paper claims processing system. This reduction was very apparent at the district and regional hospitals. The reasons for this reduction are not clearly known but they could be attributed to healthcare providers' knowledge of the ability of the electronic claims processing to streamline claims and reduce the number of spurious claims submitted to the purchaser, NHIA.

Overall, findings of this study imply that the electronic processing of claims for reimbursement is efficient from the health system payer's (purchaser) perspective but inefficient form the health system providers' perspective. In spite of this, providers are making incremental gains from processing claims electronically compared to the manual system. The additional costs incurred from E-claims could be attributed to high start-up cost and labour cost. Therefore, it is anticipated that, when evaluated over a period of more than one year, these costs would reduce further.

It is important to note that for this study, benefits data used was claims rejection rates, which were applied on volumes and values of claims reimbursed to providers by the NHIA. Nevertheless, other important benefits of the E-Claim system are worth mentioning. An essential benefit of E-Claims over paper claim is that E-Claims ensures that providers tend to rely on the stability of funds from the NHIS after providing services for clients. Furthermore, E-Claims reduces the time between claims submission and reimbursement as reported by both NHIS staff and providers involved in this study. On the insurance side, there are savings on cost of operation and management of claims. The electronic system also provides a platform to identify actions of providers that lead to fraud in the

system. On both the insurance (payer/purchaser) and provider sides, the electronic system improves the capacity to manage claims.

Notwithstanding, there are difficulties in quantifying some of the benefits of the E-claims into monetary terms. Thus, methodological challenges with cost-benefit analysis hinder the use of some of the benefits in a cost-benefit analysis. It is important to note the possibility of under-estimation of the IBCRs reported in this study with the exclusion of such key benefits of electronic claims processing. With the advancement in the methods for efficiency analysis, it will be possible to measure and incorporate indicators such as fraud, predictability in funds, and turnaround time in the estimation of the efficiency of electronic claims in the foreseeable future. With Ghana's NHIS being one of first country-level social health insurance policies in sub-Saharan Africa, there is little evidence elsewhere regarding the use of electronic claims processing that provides a comparison to Ghana's, therefore, it is difficult to identify studies assessing the comparative benefits and costs of electronic versus paper claims processing for a national health insurance programme.

CONCLUSION

The findings of this study show that the E-claims processing system is the economically preferred alternative to the paper claims. The study reinforces the recommendation of an earlier study on the scaling up of the E-claims system, even though for different reasons. Processing claims electronically improves the efficiency of the NHIS and reduces the number of claims rejected for payment on both the providers and the NHIA side, therefore, increasing their benefits compared to the manual processing of claims. However, to attain efficiency from the providers' side, the number of personnel assigned to E-claims processing would have to be reduced.

References

1. Agyepong IA, Adjei S. Public social policy development and implementation: a case study of the Ghana National Health Insurance scheme. *Health Policy Plan* 2008;23(2):150-60. doi: 10.1093/heapol/czn002 [published Online First: 2008/02/05]

2. Ansah EK, Narh-Bana S, Asiamah S, et al. Effect of Removing Direct Payment for Health Care on Utilisation and Health Outcomes in Ghanaian Children: A Randomised Controlled Trial. *PLOS Medicine* 2009;6(1):e1000007. doi: 10.1371/journal.pmed.1000007

3. McIntyre D, Garshong B, Mtei G, et al. Beyond fragmentation and towards universal coverage: insights from Ghana, South Africa and the United Republic of Tanzania. *Bulletin of the World Health Organization* 2008;86(11):871-6. doi: 10.2471/blt.08.053413 [published Online First: 2008/11/26]

4. Witter S, Garshong B. Something old or something new? Social health insurance in Ghana. *BMC International Health and Human Rights* 2009;9(1):20. doi: 10.1186/1472-698X-9-20

5. Agyepong IA, Aryeetey GC, Nonvignon J, et al. Advancing the application of systems thinking in health: provider payment and service supply behaviour and incentives in the Ghana National Health Insurance Scheme--a systems approach. *Health research policy and systems* 2014;12:35. doi: 10.1186/1478-4505-12-35 [published Online First: 2014/08/07]

6. Alhassan RK, Nketiah-Amponsah E, Arhinful DK. A Review of the National Health Insurance Scheme in Ghana: What Are the Sustainability Threats and Prospects? *PLoS One* 2016;11(11):e0165151. doi: 10.1371/journal.pone.0165151 [published Online First: 2016/11/11]

7. Andoh-Adjei F-X, Nsiah-Boateng E, Asante FA, et al. Provider preference for payment method under a national health insurance scheme: A survey of health insurance-credentialed health care providers in Ghana. *PLOS ONE* 2019;14(8):e0221195. doi: 10.1371/journal.pone.0221195

8. Ankrah Odame E, Akweongo P, Yankah B, et al. Sustainability of recurrent expenditure on public social welfare programmes: expenditure analysis of the free maternal care programme of the Ghana National Health Insurance Scheme. *Health Policy and Planning* 2013;29(3):271-79. doi: 10.1093/heapol/czt013

9. Nsiah-Boateng E, Asenso-Boadi F, Dsane-Selby L, et al. Reducing medical claims cost to Ghana's National Health Insurance scheme: a cross-sectional comparative assessment of the paper- and electronic-based claims reviews. *BMC health services research* 2017;17(1):115. doi: 10.1186/s12913-017-2054-1 [published Online First: 2017/02/09]

10. Sodzi-Tettey S, Aikins M, Awoonor-Williams JK, et al. Challenges in provider payment under the Ghana National Health Insurance Scheme: a case study of claims management in two districts. *Ghana Med J* 2012;46(4):189-99.

11. Wang H, Otoo N, Dsane-Selby L. Ghana National Health Insurance Scheme: improving financial sustainability based on expenditure review. World Bank Studies. Washington, DC: The World Bank, 2017.

12. National Health Insurance Act. National Health Insurance Act, 2012, 852 Sess. (2012). 2012.

13. MOH. Holistic Assessment of Health Sector Program of Work 2014. Accra, Ghana: Ministry of Health, 2015.

14. Yawson AE, Biritwum RB, Nimo PK. Effects of consumer and provider moral hazard at a municipal hospital out-patient department on Ghana's National Health Insurance Scheme. *Ghana Med J* 2012;46(4):200-10.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

15. Husereau D, Drummond M, Petrou S, et al. Consolidated Health Economic Evaluation Reporting Standards (CHEERS)--explanation and elaboration: a report of the ISPOR Health Economic Evaluation Publication Guidelines Good Reporting Practices Task Force. *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research* 2013;16(2):231-50. doi: 10.1016/j.jval.2013.02.002 [published Online First: 2013/03/30]

16. Ghana Statistical Service. Price Indices: Consumer Price Index Bulletin 2019 [Available from: https://statsghana.gov.gh/nationalaccount_macros.php?Stats=MTE2MTIyMjQ5Ni41NjY=/webstats/7163p83s71.

Provider submits claims

Paper claims with summary data in Excel

Web-based E-Claims entered directly into NHIA system

NHIA receives claims

NHIA district offices (around 165)

NHIA Claims Processing Centres (4 in total)

Fulfilment

Confirm volume and value of claims received

Paper claims: manual

Vetting

Adjudicate claims*

Paper claims: manual

Data entry

Collating and documenting all adjustments from fulfilment and vetting

Paper claims: manual

Generate vetting report

Report sent to both CEO's office and providers

Paper claims: manual

Initiate payment request

Paper claims: manual

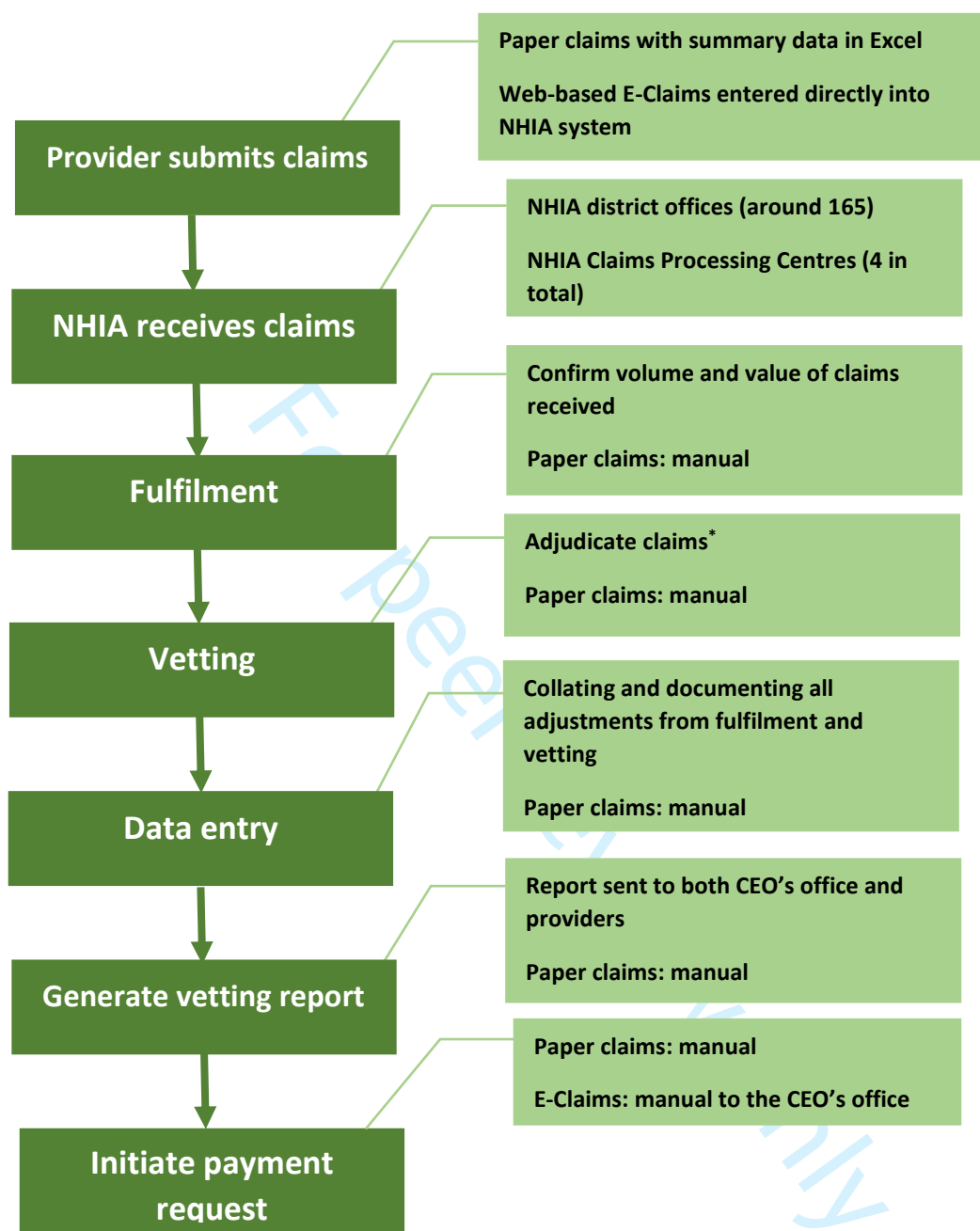E-Claims: manual to the CEO's office

Figure 1: Claims processing flowchart at the National Health Insurance Authority

Source: Authors' construct based on interviews with NHIA staff

Consolidated Health Economic Evaluation Reporting Standards – CHEERS Checklist 1

CHEERS Checklist

Items to include when reporting economic evaluations of health interventions

The **ISPOR CHEERS Task Force Report**, *Consolidated Health Economic Evaluation Reporting Standards (CHEERS)—Explanation and Elaboration: A Report of the ISPOR Health Economic Evaluations Publication Guidelines Good Reporting Practices Task Force*, provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp

Section	Item No	Recommendation	Reported on page No/line No
Title and Abstract			
Title	1	Identify the study as an economic evaluation or use more specific terms such as "cost-effectiveness analysis", and describe the interventions compared.	1
Abstract	2	Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions.	2
Introduction			
Background and objectives	3	Provide an explicit statement of the broader context for the study. Present the study question and its relevance for health policy or practice decisions.	3-4
Methods			
Target population and subgroups	4	Describe characteristics of the base case population and subgroups analysed, including why they were chosen.	4
Setting and location	5	State relevant aspects of the system(s) in which the decision(s) need(s) to be made.	4
Study perspective	6	Describe the perspective of the study and relate this to the costs being evaluated.	5
Comparators	7	Describe the interventions or strategies being compared and state why they were chosen.	5-6
Time horizon	8	State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate.	6
Discount rate	9	Report the choice of discount rate(s) used for costs and outcomes and say why appropriate.	7
Choice of health outcomes	10	Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed.	7
Measurement of effectiveness	11a	*Single study-based estimates*: Describe fully the design features of the single effectiveness study and why the single	8

Consolidated Health Economic Evaluation Reporting Standards – CHEERS Checklist 2

		study was a sufficient source of clinical effectiveness data.	
	11b	*Synthesis-based estimates*: Describe fully the methods used for identification of included studies and synthesis of clinical effectiveness data.	9
Measurement and valuation of preference based outcomes	12	If applicable, describe the population and methods used to elicit preferences for outcomes.	n.a
Estimating resources and costs	13a	*Single study-based economic evaluation*: Describe approaches used to estimate resource use associated with the alternative interventions. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	6
	13b	*Model-based economic evaluation*: Describe approaches and data sources used to estimate resource use associated with model health states. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	n.a
Currency, price date, and conversion	14	Report the dates of the estimated resource quantities and unit costs. Describe methods for adjusting estimated unit costs to the year of reported costs if necessary. Describe methods for converting costs into a common currency base and the exchange rate.	7
Choice of model	15	Describe and give reasons for the specific type of decision-analytical model used. Providing a figure to show model structure is strongly recommended.	5-6
Assumptions	16	Describe all structural or other assumptions underpinning the decision-analytical model.	n.a
Analytical methods	17	Describe all analytical methods supporting the evaluation. This could include methods for dealing with skewed, missing, or censored data; extrapolation methods; methods for pooling data; approaches to validate or make adjustments (such as half cycle corrections) to a model; and methods for handling population heterogeneity and uncertainty.	n.a
Results			
Study parameters	18	Report the values, ranges, references, and, if used, probability distributions for all parameters. Report reasons or sources for distributions used to represent uncertainty where appropriate. Providing a table to show the input values is strongly recommended.	n.a
Incremental costs and outcomes	19	For each intervention, report mean values for the main categories of estimated costs and outcomes of interest, as well as mean differences between the comparator groups. If	9-10

Consolidated Health Economic Evaluation Reporting Standards – CHEERS Checklist 3

		applicable, report incremental cost-effectiveness ratios.	
Characterizing uncertainty	20a	*Single study-based economic evaluation*: Describe the effects of sampling uncertainty for the estimated incremental cost and incremental effectiveness parameters, together with the impact of methodological assumptions (such as discount rate, study perspective).	**13-15**
	20b	*Model-based economic evaluation*: Describe the effects on the results of uncertainty for all input parameters, and uncertainty related to the structure of the model and assumptions.	n.a
Characterizing heterogeneity	21	If applicable, report differences in costs, outcomes, or cost-effectiveness that can be explained by variations between subgroups of patients with different baseline characteristics or other observed variability in effects that are not reducible by more information.	15
Discussion			
Study findings, limitations, generalizability, and current knowledge	22	Summarise key study findings and describe how they support the conclusions reached. Discuss limitations and the generalisability of the findings and how the findings fit with current knowledge.	16-17
Other			
Source of funding	23	Describe how the study was funded and the role of the funder in the identification, design, conduct, and reporting of the analysis. Describe other non-monetary sources of support.	19
Conflicts of interest	24	Describe any potential for conflict of interest of study contributors in accordance with journal policy. In the absence of a journal policy, we recommend authors comply with International Committee of Medical Journal Editors recommendations.	19

For consistency, the CHEERS Statement checklist format is based on the format of the CONSORT statement checklist

The **ISPOR CHEERS Task Force Report** provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* link or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp

The citation for the CHEERS Task Force Report is:
Husereau D, Drummond M, Petrou S, et al. Consolidated health economic evaluation reporting standards (CHEERS)—Explanation and elaboration: A report of the ISPOR health economic evaluations publication guidelines good reporting practices task force. Value Health 2013;16:231-50.

BMJ Open

Benefit cost analysis of electronic claims processing under Ghana's National Health Insurance Scheme

SCHOLARONE™
Manuscripts

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Benefit cost analysis of electronic claims processing under Ghana's National Health Insurance Scheme

Justice Nonvignon[1]*, Rebecca Addo[2], Huihui Wang[3], Anthony Seddoh[4]

[1]Department of Health Policy, Planning and Management, School of Public Health, College of Health Sciences, University of Ghana, P. O. Box LG13, Legon, Ghana
[2]Centre for Health Economics Research and Evaluation (CHERE), University of Technology Sydney, Australia
[3]The World Bank Group, Ghana, Accra, Ghana
[4]The World Bank Group, Washington, D.C, United States of America

*Corresponding author's email address: jnonvignon@ug.edu.gh

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

ABSTRACT

Objective: The aim of this study was to evaluate the benefit-cost of E-claims. A benefit-cost analysis was used to evaluate the efficiency of E-claims from the perspective of the providers and the purchaser.

Design: A benefit-cost analysis approach was taken for this economic evaluation. Further, we estimated the incremental benefit-cost ratio (IBCR) of the intervention under assessment.

Participants: Purchasers and healthcare providers of the NHIS of Ghana were the study population

Results: The analysis was stratified according to providers and purchaser. Cost incurred in processing claims electronically and manually were estimated by assessing the resource use and their corresponding costs. Sensitivity analysis was conducted to assess the robustness of the results to variations in discount rate and proportions of claims processed under E-claims compared to paper claims. The combined sample of providers and purchaser made incremental gains from processing claims electronically. The IBCR was -19.75, 25.56 and 5.10 for all (sample) providers, purchaser and both providers and purchaser, respectively. When projected for the 330 facilities submitting claims to the NHIS CPC as at December 2014, the IBCR were -35.20, 25.56 and 90.06 for all providers, purchaser and both providers and purchaser. The results were sensitive to the discount rate used and proportions of E-claims compared to paper claims.

Conclusion: Electronic processing of claims is more efficient compared to manual processing, hence provide an economic case for scaling it up to cover many more healthcare facilities and NHIS CPCs in the Ghana.

Keywords: cost-benefit analysis, electronic claims processing, national health insurance scheme, Ghana

Strengths and limitations of this study

- The study provides evidence for scaling up of the E-claims system which improves the efficiency of the NHIS compared to the manual processing of claims

- This study addressed important gaps in knowledge about electronic processing and manual processing of insurance claims in a resource-constraint setting.

- There are difficulties in quantifying some of the benefits of the E-claims into monetary terms, reflecting methodological challenges with cost-benefit analysis.

- There is little evidence available regarding the use of electronic claims processing that provides a comparison to Ghana, therefore, it was difficult to identify similar studies

BACKGROUND

Prior to the establishment of Ghana's National Health Insurance Scheme (NHIS) in 2003, the health financing system in Ghana was characterized by high out-of-pocket (OOP) payment at the point of service, low private health insurance penetration and few community-based health insurance schemes (CBHIS). Previous studies have provided a comprehensive historical overview of health financing in Ghana [1], and other contexts of the NHIS [2-4]. Other studies explored provider payment mechanisms and sustainability of expenditure under the NHIS [5-11].

The main objective of the NHIS as contained in the Act 650 establishing it (and later Act 852 2012) was "to secure the provision of basic healthcare services to persons resident in the country" [12]. The NHIS is mainly financed by value-added tax and Social Security National Insurance Trust (SSNIT) deductions, covering 95% of the disease conditions afflicting the population. A Free Maternal and Child Care policy was also introduced in 2008 with support from the British Government [8] to accelerate attainment of MDG 4 and 5, under which antenatal, delivery and post-natal care services to pregnant women were made free to clients [5]. Faced with a number of issues around governance and operations, legalities and definition of exempt groups, the National Health Insurance Act, 2012 (Act 852) was passed in 2012 [12] replacing Act 650. By the end of 2014, the NHIS had a total active membership of 10,545,428 representing 39% of the total population of Ghana [13].

Since its implementation in 2004, the NHIA, the regulator of the NHIS, has used various provider payment mechanisms (PPMs) to reimburse health service providers for use of services by NHIS members. At the start of the implementation in 2004, itemized billing with no standard fee schedule was used to reimburse providers for services and medicines. Under this PPM, providers negotiated reimbursement rates with the NHIS office at the district level. In 2008, the Ghana-Diagnostic Related Grouping (G-DRG) payment mechanism was introduced to address challenges such as the inability of healthcare providers to code claims properly (resulting in the submission of incomplete claims); escalating costs due to spurious claims; and the lack of a system to monitor fraud. The G-DRG was used to pay for services and procedures while payment for medicines was made using standardized itemized fees (fee-for-service) based on a medicines list [5 7]. Under the G-DRG payment system, facilities submit claim forms filled for each outpatient visit and inpatient episode (coded under G-DRG) to NHIS for reimbursement. In addition, due to continued cost escalation, some of which has been attributed to fraud and moral hazards [14], per capita (capitation) payment mechanism for primary health care services was introduced in 2012. This was piloted in the Ashanti region [5 7] and was scaled up to two additional regions but was halted in 2017.

In the search of a more efficient method of reimbursing providers while financially sustaining the NHIS, the electronic claims (E-claims) processing was introduced in 2013 [11]. This initiative was part of the World Bank-supported health Insurance Project (HIP) whose main objective was to create an enabling environment for the scheme and facilitate its financial and operations management. The E-claims processing was piloted in 29 health facilities (providers) by the end of the project in March 2014. In 2019, the E-claims covered 120 healthcare facilities across the country and received a quarter of total volumes of claims submitted to National Health Insurance Authority (NHIA), the purchaser.

Description of E-Claims system

E-Claims refers to any claim that is captured on a CD, Memory stick, on-line real time, through a Web Front End model or through Health Management Information System. The purpose of introducing electronic claims was to

minimize the extent of human interference in the claims adjudication process, minimize errors association in claims processing from the healthcare provider end and its adjudication process at the NHIA. At the insurance side, a national Claims Processing Centre (CPC) was equipped to process electronic claims from providers across the country. At the service provider side, 29 health facilities were initially selected to submit claims through two options: 1) an XML (Extensible Markup Language) interface that transmits claim information from the provider's HMIS and electronic health record system (EHRS), and 2) Web-based tool for entering and submitting claim information. These claims are submitted to the purchaser, the NHIA' CPC in Accra, where they are equipped to electronically vet and process the E-claims submitted by providers. Under Paper-claims system, on the other hand, providers fill out claims forms per patient and submit all the forms compiled over a period to the purchaser for reimbursement.

In terms of claims processing, both E-claims and Paper-claims systems follow the same steps to process claims for reimbursement. For instance, at the purchaser side, once the CPC receives claims from the providers, they confirm the volume and value of the claims received. Afterwards, the claims are vetted to assess providers' adherence to eligibility, benefit package, Ministry of Health (MOH) treatment protocols, diagnosis, prescribing levels, treatment and tariffs assigned to each claim. Any deviation from the NHIS requirements are accounted for by adjusting claims submitted, after which reports are written and submitted to the providers and the Chief Executive Officer of the NHIA. The difference between the electronic and manual claims is that whereas the processing steps outlined above are automated either fully or partially under the former, the later are carried out manually. At the provider's side, once they submit the claims to the CPC either electronically or by claim forms, data are entered for the manual claims, but the remaining steps carried out by the CPC as described above. Figure 1 presents the steps involved in processing claims under the NHIS. Both processes require labour capacity to undertake entry of data into the web-interface for the E-claims and filling and compiling of forms under the manual claims. In addition to this, a provider requires a computer, UPS, sustained internet connection, staff with the appropriate skills and electricity to submit E-claims. Details of NHIA claim review and reimbursement process can be found elsewhere [9].

At the end of the pilot phase, a number of benefits were observed for the service providers, scheme managers and in the interactions between providers and scheme managers. For service providers, there were 1) cost savings with regards to operations cost by not using paper; 2) decreased rejection rate due to better quality claims; 3) decreased turn-around time for reimbursement and 4) increased fund stability. For scheme managers, there were 1) saved operation and management cost for claim processing by not using cumbersome paper-based system; 2) saved operation and management cost for clinical auditing; 3) increased capacity and efficiency to identify fraud claims; 4) increased capacity and efficiency to identify inappropriate services and improve service quality; and 5) increased capacity to provide evidence for policy making and implementation. Lastly, with regards to the benefits accrued in the interactions between providers and scheme managers, there were, 1) increased capacity to link up with digitalized membership management system, electronic insurance payment system, electronic medical records system in hospitals and health information management system and 2) improved human resource capacity to implement administration requirement of the health insurance scheme.

[Figure 1]

To demonstrate the effectiveness of E-claims over paper claims processing, Nsiah-Boateng et al.[9], used a cross-sectional study to compare the ability of E-claims and paper claims processing to detect spurious claims and reduce costs to the NHIA. The authors found that the E-claims review system had the ability to reduce cost to the NHIA more than paper claims (17% vs 4.9%). While this study demonstrates that E-claims is effective in reducing cost to the NHIA compared to paper claims processing, the costs and benefits of processing claims electronically or manually to providers and the overall health system is not known. A comprehensive economic evaluation could contribute to informed decision on which claims processing type provides value-for-money to both providers and the overall health system. Therefore, the aim of this study was to assess the costs and benefits of E-claims compared to the paper claims processing to inform policy makers, as well as fill a gap in the literature.

METHODS

Study design

A benefit-cost analysis approach was taken for this economic evaluation. BCA assesses the costs and benefits of an intervention compared to the next best alternative. Unlike other types of evaluations, BCA assesses the monetary value of the benefits [15-18]. Its theoretical foundations are from the concept of Pareto efficiency, where an additional re-allocation is acceptable only if it makes at least one person better off without making another person worse off (ref). In this study, we estimate the incremental benefit-cost ratio (IBCR) of the intervention under assessment. The IBCR in a BCA denotes the net benefit of an intervention compared to its best alternative. Therefore, using BCA, an intervention is said to be efficient compared to the next best alternative if the net benefit is positive.

Thus, this study sought to assess the efficiency of the E-claims compared to paper-claims system, and to establish if the marginal benefits of processing claims electronically at least covers its marginal cost: implying positive net benefits, or not. We report our methods and results in accordance with the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) [19].

Study population

Purchasers and healthcare providers of the NHIS of Ghana were the study population. As at December 2014, there were 330 district hospitals, eight secondary hospitals and one tertiary hospital submitting claims, out of which 29 were implementing E-claims. The purchaser selected was the claims processing centre (CPC) of the NHIS. For the purposes of this evaluation, 11 providers were purposively sampled out of a total of 29 providers implementing E-claims; four districts and five regional hospitals who were processing their claims electronically were selected based on the start dates of the E-claims system (i.e. we selected facilities that had processed E-claims for at least one year prior to evaluation); the Police hospital and the 37 Military hospital were also selected based on their experience with implementing the E- claims. Therefore, in addition to estimating the overall net benefit of E-claims processing in Ghana, the analysis was further categorised into the following subgroups; district, regional, tertiary and central processing centre. No patient level data were accessed as part of this study. **Perspective of analysis**

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

The evaluation was conducted from the perspective of the Ghana health system to establish whether it was worthwhile for the system to invest in the E-claims by extending its coverage to all providers and NHIS processing centres.

Estimating costs

Data on resource use and their associated costs were obtained from the NHIA and providers under study. At the providers' side, annual cost data were collected – year 2012 for costs involved in processing paper claims (all facilities under study were using paper claims) and year 2014 for costs involved in E-claims processing (all facilities under study had rolled out E-claims processing fully). At the purchaser side, data was collected for only year 2014 for both the costs of processing paper claims and E-claims. This was because at the time, the CPC was processing both types of claims since not all providers had been enrolled onto the E-claims system. However, the cost data collected were disaggregated into paper and electronic claims by weighting the total claims by the proportions of E-claims and paper claims processed during 2014.

The costs information collected included capital and recurrent costs. Capital costs included the costs of installation (server and software purchase/upgrade, internet) and equipment (printers, computers, air conditioner, routers, and inverter). Recurrent costs included labour, transport, staff training, operations costs (office space/storage space rental costs, furniture) electricity bills, and stationery.

The total capital costs incurred by the providers were calculated by summing the costs attributable to each capital cost item. Further, since the start-up costs for the E-claims reflect costs of inputs spanning over more than one year, the equivalent annual cost (EAC) of capital items was derived by dividing the total capital cost (summed for all units of a given capital item) by the annualization factor. This was done to enable summation of capital costs with recurrent costs that occurred within one year. The annualization factor was derived from annuity tables using the useful life of each capital item (3 years were assigned for printers, UPS, stabilizer, router and batteries; and 5 years were assigned for other capital items including computer based on discussions with providers) and a discount rate of 3%, as recommended for the conduct of economic evaluation in low middle income countries [20-22]. Thus, the total capital cost (for E-Claims and paper claims) for a provider was derived by summing the EACs for all capital inputs.

The total cost incurred by the provider for each recurrent item was also calculated by multiplying the unit costs by quantity. Total recurrent cost was calculated by summing the recurrent costs that providers attributed to recurrent items they used in processing both E-Claims and paper claims. Data on the number of staff under each staff category involved in processing claims (E-Claims and paper claims) for each provider together with the proportion of time that each staff spends per month on claims processing and the gross monthly salary of each staff were collected. The labour cost per staff attributable to claim processing was calculated by multiplying the total monthly gross salary by the proportion of time spent. This was summed over one year and across staff categories to derive the total labour costs, which were then added to the recurrent costs. The costs of the paper claims were converted into 2014 estimates: base year of analysis, using the consumer price indices (CPIs) for health goods collected from the Ghana Statistical Service [23]. The total costs per providers were estimated by summing capital and recurrent costs. Cost per claim processed under each type of claims processing were derived by dividing the total costs by the total number of claims processed.

From the purchaser's side, the total operational costs (i.e. excluding capital and other investment costs) of the NHIA for 2014 was collected and used to apportion operational costs to the CPC based on the proportion of staff

in the CPC as compared with the total number of staff of NHIA. The assumption here is that the proportion of staff reflects the proportion of not only staff time but also other operational expenses that could be attributed to the activities of the CPC. This was done as it was difficult to disaggregate specific cost items for the CPC. Once the operational costs attributable to CPC was derived, the proportion of E-Claims or paper claims processed by the CPC was used to apportion the CPC operational costs to either E-Claims or paper claims. Then, the cost per claim was derived by dividing the total costs of E-Claims/paper claims by the total volume/number of such claims processed by the CPC. The cost analysis was performed in Ghana Cedis (GHS) and converted into United States Dollars (US$) using the US$-GHS exchange rate for June 30, 2014 (3.00) accessed from www.xe.com. The choice of cost parameters was based on the relevant costs incurred under both claims processing types, given the types of resources expended on various activities undertaken as part of claims processing.

Estimating benefits

The benefits of claims were assessed using: 1) volumes and values of claims reimbursed and 2) claims rejection rate. For the providers, the volumes of claims were the total number of claims submitted for reimbursement. Subsequently, the values of the claims were estimated as their expected payout from the NHIS. Claims rejection rate was estimated as the difference between the claims submitted for reimbursement and the actual number of claims that were reimbursed by the NHIS. In other words, the difference between the projected value claims submitted and the actual payout received from the NHIS. The claims rejection rate was estimated for each month and that for the one-year period estimated as the average rejection rate per month for year 2012 and 2014 for paper claims and E-claims respectively.

Therefore, benefits of E-claims and paper claims per provider was estimated as the difference between the value of the submitted claims and the value of claims reimbursed (accounting for claims rejection rate). The value per claim submitted per provider was calculated by dividing the total value of claims submitted by the total volume of claims submitted.

On the other hand, the benefits of either types of claims processing to the purchaser (NHIA CPC) was estimated as the costs saved from the payouts that were not made due to rejection of submitted claims from providers. Thus, they were calculated as the cost due to rejected claims; that is, the difference between the expected payout for claims submitted by providers and the actual payout made after adjusting for claims rejected. The choice of benefit parameters was based on realistic availability of data from both providers and the purchaser.

Estimating incremental benefit-cost ratios

Incremental costs were calculated as a difference between the cost of E-claims and paper claims. The incremental benefits were calculated as the difference between the benefits of the E-claims and paper claims (Table 1). The incremental benefit-cost ratios (IBCRs), a measure of efficiency, were therefore estimated for each provider and CPC (or purchaser) by dividing incremental benefits ($B_{\text{E-claims}}$-$B_{\text{paper claims}}$) by incremental costs ($C_{\text{E-claims}}$-$C_{\text{paper claims}}$). The IBCR per specific unit (that is provider or purchaser) determines the efficiency of that unit. An IBCR greater than 1 indicates that the additional benefits of E-claims outweigh the additional costs. The IBCR was calculated for each provider, provider type (i.e. district/regional/teaching hospital), purchaser and the entire health system (that is, both providers and purchaser). The analysis for provider type used the average costs and benefits of each provider type (i.e. summing for all units in the specific provider type within the study sample and dividing

by the number of units). The analysis for the health system was done by adding the costs and benefits of all providers and purchaser and estimating their IBCR.

Furthermore, the analysis was extended to cover total number of providers (by type) projected to submit claims to the CPC as at December 2014. It is worthy to note that 91% of these facilities were not processing their claims electronically at the time of data collection. The costs and benefits were calculated by multiplying the average costs and benefits of providers (according to type) to the total number of providers using E-claims at the time of evaluation. There was only one E-claims processing centre for the NHIA as at 2014.

Table 1: Detailed calculation formulas

Estimating costs	
Provider	
Total costs	Total Recurrent costs + Total capital costs
Capital costs	Sum of equivalent annual cost of capital
Equivalent annual capital cost	Current cost of capital / annualization factor
Recurrent cost	Unit cost * quantity for each item
Purchaser	
Total operational cost of CPC	Total operational cost of NHIA * proportion of CPC staff to total staff
Operational cost of e-Claims or Paper claims	Total CPC operational cost * proportion of staff processing e-claims or paper claims
Estimating benefits	
Provider	
Benefits of e-Claims or paper claims	Total value of submitted – total value of reimbursed claims
Purchaser	
Cost savings	Expected payouts from submitted claims – actual payout/reimbursement
Incremental benefit-cost ratio	
Incremental cost	Total cost of e-claims – Total cost of paper claims
Incremental benefit	Total benefit of e-claims – Total benefit of paper claims
IBCR	Incremental benefit / incremental cost

Sensitivity analysis

Some key parameters of the study were varied to ascertain the robustness of the IBCRs estimates. A univariate sensitivity analysis was conducted on the discount rate and the proportions of claims processed under E-claims compared to paper claims. The discount rates were varied within a range of 0% to 10%, excluding 3%, the base case.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting or dissemination plans of our research.

RESULTS

Costs of processing E-claims and Paper claims

Table 2 presents the costs per claim for the two processing types for the study population: providers and purchaser. The average cost per E-claim for the providers was US$0.65, US$0.93 and US$1.95 for the district, regional and tertiary hospitals respectively. The providers also incurred an average cost per paper claim of US$0.30, US$1.16, and US$2.26 for the district, regional and tertiary hospitals respectively. The total cost per claim for all providers was US$10.18 and US$10.45 for E-claims and paper claims respectively. Among the providers, the cost of processing[1] both electronic and paper claims were highest among tertiary hospitals. In addition, Volta regional hospital spent the highest cost in processing E-claims followed by La General Hospital. Conversely, Atebubu hospital incurred the least cost in processing E-claims. In processing paper claims, Volta regional hospital incurred the highest cost followed 37 Military hospital. Takoradi hospital spent the least in processing paper claims. The purchaser; NHIS CPC incurred US$0.59 for processing each E-claim and US$0.50 for processing each paper claim at the CPC.

Recurrent costs accounted for a higher percentage of the costs of processing both E-claims and paper claims for providers and purchasers alike. For example, for district hospitals recurrent costs constituted 86% of E-claims processing costs and 96% of paper claims processing costs (see additional file for detailed description). The main driver of the recurrent cost was labour, followed by maintenance. It is worthy to note that start-up cost of E-claims contributed to 13.6%, 8.7%, 8.3% of the overall costs for district, regional and tertiary hospitals respectively. Cost of labour also accounted for 50-76% of costs of E-claims and 59-83% of costs of paper claims.

---

[1] The cost of processing claims includes all costs incurred from preparing and submitting claims

Table 2: Estimated costs of processing E-claims and paper claims by healthcare providers and purchaser, 2014

Study population	Cost per claim (US$)	
	E-claims	**Paper claims**
Providers		
District		
Atebubu hospital	0.27	0.22
St. Martins hospital	0.59	0.29
Takoradi hospital	0.29	0.12
La general hospital	1.46	0.57
Average District	*0.65*	*0.30*
Total district	*2.61*	*1.2*
Regional		
Sunyani hospital	0.90	0.29
Koforidua hospital	0.61	1.25
Ridge hospital	0.81	0.32
Police hospital	0.74	1.95
Volta hospital	2.00	2.60
Effia Nkwanta hospital	0.56	0.58
Average Region	*0.94*	*1.17*
Total region	*5.62*	*6.99*
Tertiary		
37 Military hospital	1.95	2.26
All providers		
Average	0.93	0.95
Total	10.18	10.45
Purchaser		
CPC	0.59	0.50
Health system (All providers and Purchaser)		
Average	0.90	0.91
Total	10.77	10.95

Note:

All costs were estimated in 2014. A conversion rate of GHC3.00 per US$1 was used.

Abbreviation: CPC; claims processing centre, E-claims; electronic claims

Benefits of processing E-claims and paper claims

Table 3 presents the benefits of E-claims and paper claims to the healthcare providers and the purchaser (NHIA). The average value per E-claim without errors (that is expected payout) for the providers was US$9.29, US$14.96 and US$114.31 for the district, regional and tertiary hospitals respectively. The average value per paper claim without errors was US$8.22, US$13.87 and US$18.26 for the district, regional and tertiary hospitals

respectively. When put together, all providers were expected to gain US$128.31 per E-claim and US$125.52 per paper claim as claims payout.

The NHIA expected payout for processing claims electronically and manually were US$11.26 and US$9.71 per claim respectively. However, after correcting for errors, they paid out US$11.03 per E-claim submitted and US$ 8.74 per paper claim submitted by providers, hence making a cost savings (benefits) of US$ 0.23 and US$ 0.97 for each electronic and paper claim submitted by providers respectively.

The average rejection rates for E-claims versus paper claims were 3% (0.001% - 10%) vs 10% for the district hospitals, 1% vs 6 for regional hospitals, 0% vs. 6% for tertiary hospital, 2% vs 10% NHIA respectively. The highest rejection rate was seen among paper processing of claims for both providers and purchaser.

Table 3: Estimated benefits of E-claims and Paper claims by providers and purchaser, 2014

Study population	Value per claim submitted		Rejection rate (%)		Value per claim reimbursed (US$) (accounting for rejection rate)	
	E-claims	Paper claims	E-claims	Paper claims	E-claims	Paper claims
Providers						
District						
Atebubu hospital	9.06	8.82	10.00	20.00	8.16	7.05
St. Martins hospital	9.81	12.42	0.00	5.00	9.81	11.80
Takoradi hospital	9.07	4.65	0.10	0.10	9.06	4.64
La general hospital	10.15	9.67	0.00	3.00	10.15	9.38
Average District	*9.52*	*8.89*	-	-	*9.29*	*8.22*
Total district	*38.08*	*35.55*	-	-	*37.17*	*32.87*
Regional	0.00	0.00				
Sunyani hospital	15.94	14.51	2.40	3.00	15.56	14.08
Koforidua hospital	16.62	15.13	-	12.50	16.62	13.24
Ridge hospital	17.06	14.21	0.30	3.00	17.01	13.78
Police hospital	12.58	14.53	0.50	15.00	12.52	12.35
Volta hospital	12.98	16.44	-	0.00	12.98	16.44
Effia Nkwanta hospital	15.05	15.15	0.60	12.00	14.96	13.33
Average Region	*15.04*	*15.00*	-	-	*14.96*	*13.87*
Total region	*90.23*	*89.97*	-	-	*89.64*	*83.22*
Tertiary						
37 Military hospital	14.31	19.48	-	6.30	14.31	18.26
All providers						
Average	11.66	11.41	-	-	11.55	10.50

Study population	Value per claim submitted		Rejection rate (%)		Value per claim reimbursed (US$) (accounting for rejection rate)	
	E-claims	Paper claims	E-claims	Paper claims	E-claims	Paper claims
Total	128.31	125.52	-	-	126.81	116.09
Purchaser						
CPC (NHIA)	11.26	9.71	2.00	10.00	0.23	0.97
Health system (All providers and purchaser)						
Average	11.63	11.27	-	-	10.59	9.76
Total	139.58	135.23	-	-	127.04	117.07

Note: All costs were estimated in 2014. A conversion rate of GHC3.00 per US$1 was used.

Abbreviation: CPC; claims processing centre, E-claims; electronic claims

Incremental benefit cost ratio of processing E-claims and paper claims

Table 4 presents a summary of the incremental benefit-cost ratios (IBCRs) by study population (study units). The incremental cost for all providers was estimated at US$-0.27 and that for the purchaser (CPC of the NHIA) was US$0.09. When stratified by types of providers, the average incremental cost per E-claim per district, regional and tertiary hospitals were US$0.35, US$-0.23, and US$-0.31 respectively. The average incremental benefits per E-claim were US$1.07 for district hospitals, US$1.07 for regional hospitals, US$-3.94 for tertiary hospital and US$-0.75 for CPC. Overall, the incremental benefit for all providers was estimated at US$10.72 and purchaser and providers was US$ 9.97 per E-claim.

The IBCR was 3.05 for district hospitals, -4.69 for regional hospitals, 12.72 for tertiary hospital and -8.28 for CPC. Two out of four district hospitals recorded IBCRs of less than one: St Martin's hospital (-6.65) and La general hospital (0.86). Three regional hospital also had an IBCR of less than one: Koforidua regional hospital (-5.28), Police hospital (-0.14) and Efia Nkwanta regional hospital (-81.49). The overall IBCR for all providers was -25.09 and that for the health system was -33.49.

Table 4: Incremental benefit-cost ratio of processing E-claims and paper claims by healthcare providers and purchaser, 2014

Study population	Incremental cost (US$)	Incremental benefits (US$)	IBCR
Providers			
District			
Atebubu hospital	0.05	1.10	22.07
St. Martins hospital	0.3	(1.99)	(6.65)
Takoradi hospital	0.17	4.42	25.97
La general hospital	0.89	0.77	0.86
Average District	*0.35*	*1.07*	*3.05*

Study population	Incremental cost (US$)	Incremental benefits (US$)	IBCR
Total district	*1.41*	*4.29*	*3.05*
Regional			
Sunyani hospital	0.61	1.48	2.43
Koforidua hospital	(0.64)	3.38	(5.28)
Ridge hospital	0.49	3.22	6.58
Police hospital	(1.21)	0.17	(0.14)
Volta hospital	(0.60)	-3.46	5.77
Effia nkwanta hospital	(0.02)	1.63	(81.49)
Average Region	*(0.23)*	*1.07*	*(4.69)*
Total region	*(1.37)*	*6.42*	*(4.69)*
Tertiary			
37 Military hospital	(0.31)	(3.94)	12.72
All providers			
Average	(0.02)	0.97	(48.71)
Total	(0.27)	6.77	(25.09)
Purchaser			
CPC (NHIA)	0.09	(0.75)	(8.28)
Health system (All providers and purchaser)			
Average	(0.01)	0.83	(83.09)
Total	(0.18)	6.03	(33.49)

Note:

All costs were estimated in 2014. A conversion rate of GHC3.00 per US$1 was used.

Abbreviation: CPC; claims processing centre, E-claims; electronic claims

Values in parenthesis denote negative values

Table 5 further presents the IBCR of all providers nationwide submitting claims to the NHIS CPC as at the end of 2014. The IBCR extrapolated for providers and purchaser nationwide were 3.05 for district hospitals, -4.69 for regional hospitals, 12.72 for tertiary hospitals and -8.28 for the CPC. IBCR for all providers nationwide was 11.08 and the entire health system was 2.79.

Table 5: Extrapolated IBCR for all providers submitting claims to the NHIA CPC as at the end of year 2014

Study population	Incremental cost (US$)	Incremental benefits (US$)	IBCR
^Providers			
All district hospitals	347.98	1706.80	4.90
All regional hospitals	(231.64)	764.98	(3.30)
Tertiary hospitals	(307.18)	(3953.13)	12.87
All providers	*(63.61)*	*2239.18*	*(35.20)*
Purchaser			

Study population	Incremental cost (US$)	Incremental benefits (US$)	IBCR
CPC	89.97	2300.02	25.56
Health system			
All providers and purchaser	26.36	2373.95	90.06

^Providers submitting claims to CPC by end 2014; All costs and benefits were estimated in 2014. A conversion rate of GHC3.00 per US$1 was used; Values in parenthesis denote negative values

Study population	Incremental cost (US$)	Incremental benefits (US$)	IBCR
*Providers			
All district hospitals	116.33	354.31	3.05
All regional hospitals	(1.83)	8.56	(4.69)
Tertiary hospitals	(0.31)	(3.94)	12.72
All providers			
Average	(91.53)	3633.04	(39.69)
Total	***114.19***	***358.93***	***11.08***
Purchaser			
CPC	0.09	(0.75)	(8.28)
Health system (All providers and purchaser)			
Average	(3.4)	282.52	(83.09)
Total	***114.28***	***358.18***	***2.79***

*All providers nationwide; All costs and benefits were estimated in 2014; A conversion rate of GHC3.00 per US$1 was used; Values in parenthesis denote negative values; As at the period of data collection, there were 330 districts hospitals, eight regional hospitals, one tertiary hospital and one NHIS CPC using E-claims processing

3.4 Sensitivity analysis

The results of the sensitivity analysis showed that increasing the discount rate for both costs and benefits led to reductions in the IBCRs for each study unit and vice versa. However, this change did not influence the direction of the findings: from being efficient to not efficient and vice versa. For example, a 10% discount rate did not change the claims processing of a provider or purchaser from being profitable to unprofitable. When the proportions of E-claims to total claims were increased, the IBCR of the NHIA CPC reduced. For instance, increasing the proportion of E-Claims from the base of 29% to 50% as against 50% paper claims (from 71% at base) reduced the IBCR from 15.14 to 2.32. The analysis shows that if all claims were processed electronically, 100% the IBCR will be less than one (0.76), indicating that the incremental cost of processing additional claims exceeds incremental benefits. The CPC of NHIS can only achieve IBCR of one when 81% of claims are processed electronically and 19% processed manually. Any higher proportion of E-Claims worsens the IBCR.

DISCUSSION

Analysis of the benefits and costs of the E-claims and paper claims processing systems of the NHIA show that electronic processing of clams is more efficient than the manual system. On the average, all providers spent less cost in processing E-claims compared to paper claims. However, contrary to what was expected, the E-claims was more labour intensive. This could be attributed to providers associating efficiency of claims processing to the number of staff assigned to it: the higher the number of staff, the more efficient the processing and vice versa. Therefore, a more cost saving approach in terms of less labour under the E-claims could improve the efficiency gains by reducing the costs of processing. On the other hand, the purchaser (NHIA) spent more money to process claims electronically compared to manual system. The reason for this is not readily known but might be due to maintenance cost of the E-claims infrastructure. The E-claims set-up requires periodic repairs and upgrade by the service provide to make it more robust and efficient, and this comes with cost to the NHIA.

Generally, the healthcare providers and the purchaser (NHIA) benefit more from processing claims using the electronic system than manual one. This assertion stems from the higher rejection rates from the E-claims processing system, compared to the paper claims processing system: 7.26% versus 1.26% for all providers and 10% versus 2% for the NHIS. Higher claims rejection by E-claims implies better ability to detect errors in submitted claims.These findings confirm the study by Nsiah-Boateng et al., which reported that the E-claims processing system has a higher claims rejection rate than the paper claims processing system, and concluded that the former could reduce cost to the NHIS. However, the claims rejection rates reported by our study were different from that reported by Nsiah-Boateng et al [9]. For example, while they reported an adjustment rate of 17.9% for district hospitals using E-claims, we estimated 10% claims rejection rate for district hospitals. The difference in the rejection rate size could be attributed to the different methodological approaches employed to estimate effectiveness of E-claims processing system, the number and type of facilities used for both studies, and the study period.

This study also reveals a reduction in the volumes of claims submitted by providers under the E-claims compared to the paper claims processing system. This reduction was very apparent at the district and regional hospitals. The reasons for this reduction are not clearly known but they could be attributed to healthcare providers' knowledge of the ability of the electronic claims processing to streamline claims and reduce the number of spurious claims submitted to the purchaser, NHIA.

Overall, an important implication of the findings of this study for policy is that the electronic processing of claims for reimbursement is efficient from the health system payer's (purchaser). Therefore, E-claims has the potential to reduce costs to the insurance system overall. In addition, E-claims improves claims processing times from both provider and insurance perspectives, with potential improvement in quality. Moreover, providers are making incremental gains from processing claims electronically compared to the manual system. The additional costs incurred from E-claims could be attributed to high start-up cost and labour cost. Therefore, it is anticipated that, when evaluated over a period of more than one year, these costs could reduce further.

It is important to note that for this study, benefits data used was claims rejection rates, which were applied on volumes and values of claims reimbursed to providers by the NHIA. Nevertheless, other important benefits of the E-Claim system are worth mentioning. An essential benefit of E-Claims over paper claim is that E-Claims ensures that providers tend to rely on the stability of funds from the NHIS after providing services for clients. Furthermore,

E-Claims reduces the time between claims submission and reimbursement as reported by both NHIS staff and providers involved in this study. On the insurance side, there are savings on cost of operation and management of claims. The electronic system also provides a platform to identify actions of providers that lead to fraud in the system. On both the insurance (payer/purchaser) and provider sides, the electronic system improves the capacity to manage claims.

Study limitations

The study findings notwithstanding, some limitations are worth mentioning. First, difficulties in quantifying some of the benefits of the E-claims into monetary terms, for example as discussed in the previous paragraph. Thus, methodological challenges with cost-benefit analysis hinder the use of some of the benefits in a cost-benefit analysis [15-18]. It is important to note the possibility of under-estimation of the IBCRs reported in this study with the exclusion of such key benefits of electronic claims processing. With the advancement in the methods for efficiency analysis, it will be possible to measure and incorporate indicators such as fraud, predictability in funds, and turnaround time in the estimation of the efficiency of electronic claims in the foreseeable future. Second, with Ghana's NHIS being one of first country-level social health insurance policies in sub-Saharan Africa, there is little evidence elsewhere regarding the use of electronic claims processing that provides a comparison to Ghana, therefore, it is difficult to identify studies assessing the comparative benefits and costs of electronic versus paper claims processing for a national health insurance programme.

CONCLUSION

The findings of this study show that the E-claims processing system is the economically preferred alternative to the paper claims. The study reinforces the recommendation of an earlier study on the scaling up of the E-claims system, even though for different reasons. Processing claims electronically improves the efficiency of the NHIS and reduces the number of claims rejected for payment on both the providers and the NHIA side, therefore, increasing their benefits compared to the manual processing of claims. However, to attain efficiency from the providers' side, the number of personnel assigned to E-claims processing would have to be reduced.

Figure 1: Claims processing flow chart at the National health Insurance Authority

Patient consent for publication: Not required

Ethics approval:
Permission for the study was obtained from the National Health Insurance Authority (NHIA).

Contributors
JN and WH conceived the study. JN designed the study, collected and analyzed data. JN and RA prepared the first draft of the manuscript. WH and ATS reviewed and provided substantial comments to first draft. All authors read and approved the final manuscript.

References

1. Agyepong IA, Adjei S. Public social policy development and implementation: a case study of the Ghana National Health Insurance scheme. *Health Policy Plan* 2008;23(2):150-60. doi: 10.1093/heapol/czn002 [published Online First: 2008/02/05]

2. Ansah EK, Narh-Bana S, Asiamah S, et al. Effect of Removing Direct Payment for Health Care on Utilisation and Health Outcomes in Ghanaian Children: A Randomised Controlled Trial. *PLOS Medicine* 2009;6(1):e1000007. doi: 10.1371/journal.pmed.1000007

3. McIntyre D, Garshong B, Mtei G, et al. Beyond fragmentation and towards universal coverage: insights from Ghana, South Africa and the United Republic of Tanzania. *Bulletin of the World Health Organization* 2008;86(11):871-6. doi: 10.2471/blt.08.053413 [published Online First: 2008/11/26]

4. Witter S, Garshong B. Something old or something new? Social health insurance in Ghana. *BMC International Health and Human Rights* 2009;9(1):20. doi: 10.1186/1472-698X-9-20

5. Agyepong IA, Aryeetey GC, Nonvignon J, et al. Advancing the application of systems thinking in health: provider payment and service supply behaviour and incentives in the Ghana National Health Insurance Scheme--a systems approach. *Health research policy and systems* 2014;12:35. doi: 10.1186/1478-4505-12-35 [published Online First: 2014/08/07]

6. Alhassan RK, Nketiah-Amponsah E, Arhinful DK. A Review of the National Health Insurance Scheme in Ghana: What Are the Sustainability Threats and Prospects? *PLoS One* 2016;11(11):e0165151. doi: 10.1371/journal.pone.0165151 [published Online First: 2016/11/11]

7. Andoh-Adjei F-X, Nsiah-Boateng E, Asante FA, et al. Provider preference for payment method under a national health insurance scheme: A survey of health insurance-credentialed health care providers in Ghana. *PLOS ONE* 2019;14(8):e0221195. doi: 10.1371/journal.pone.0221195

8. Ankrah Odame E, Akweongo P, Yankah B, et al. Sustainability of recurrent expenditure on public social welfare programmes: expenditure analysis of the free maternal care programme of the Ghana National Health Insurance Scheme. *Health Policy and Planning* 2013;29(3):271-79. doi: 10.1093/heapol/czt013

9. Nsiah-Boateng E, Asenso-Boadi F, Dsane-Selby L, et al. Reducing medical claims cost to Ghana's National Health Insurance scheme: a cross-sectional comparative assessment of the paper- and electronic-based claims reviews. *BMC health services research* 2017;17(1):115. doi: 10.1186/s12913-017-2054-1 [published Online First: 2017/02/09]

10. Sodzi-Tettey S, Aikins M, Awoonor-Williams JK, et al. Challenges in provider payment under the Ghana National Health Insurance Scheme: a case study of claims management in two districts. *Ghana Med J* 2012;46(4):189-99.

11. Wang H, Otoo N, Dsane-Selby L. Ghana National Health Insurance Scheme: improving financial sustainability based on expenditure review. World Bank Studies. Washington, DC: The World Bank, 2017.

12. National Health Insurance Act. National Health Insurance Act, 2012, 852 Sess. (2012). 2012.

13. MOH. Holistic Assessment of Health Sector Program of Work 2014. Accra, Ghana: Ministry of Health, 2015.

14. Yawson AE, Biritwum RB, Nimo PK. Effects of consumer and provider moral hazard at a municipal hospital out-patient department on Ghana's National Health Insurance Scheme. *Ghana Med J* 2012;46(4):200-10.

15. Briggs A, Claxton K, Sculpher MJ. Decision Modelling for Health Economic Evaluation. Oxford Oxford University Press 2006.

16. Drummond MF, Sculpher MJ, Claxton K, et al. Methods for the Economic Evaluation of Health Care Programmes. 4th ed. Oxford: Oxford University Press 2015.

17. Gray AM, Clarke PM, Wolstenholme JL, et al. Applied methods of cost-effectiveness analysis in healthcare. . Oxford Oxford University Press 2011.

18. Lane R, Soyemi A, Corso PS. Part IV: Benefit-Cost Analysis. Outcomes Quantified in Dollars: The Fourth of a Five-Part Series [PowerPoint Presentation].

19. Husereau D, Drummond M, Petrou S, et al. Consolidated Health Economic Evaluation Reporting Standards (CHEERS)--explanation and elaboration: a report of the ISPOR Health Economic Evaluation Publication Guidelines Good Reporting Practices Task Force. *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research* 2013;16(2):231-50. doi: 10.1016/j.jval.2013.02.002 [published Online First: 2013/03/30]

20. Claxton KP, Revill P, Sculpher MJ, et al. The Gates Reference Case for Economic Evaluation (MEEP). London: NICE International, 2014.

21. Sanders GD, Neumann PJ, Basu A, et al. Recommendations for Conduct, Methodological Practices, and Reporting of Cost-effectiveness Analyses: Second Panel on Cost-Effectiveness in Health and Medicine. *Jama* 2016;316(10):1093-103. doi: 10.1001/jama.2016.12195 [published Online First: 2016/09/14]

22. Wilkinson T, Sculpher MJ, Claxton K, et al. The International Decision Support Initiative Reference Case for Economic Evaluation: An Aid to Thought. *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research* 2016;19(8):921-28. doi: 10.1016/j.jval.2016.04.015 [published Online First: 2016/12/19]

23. Ghana Statistical Service. Price Indices: Consumer Price Index Bulletin 2019 [Available from: https://statsghana.gov.gh/nationalaccount_macros.php?Stats=MTE2MTIyMjQ5Ni41 NjY=/webstats/7163p83s71.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Provider submits claims

Paper claims with summary data in Excel

Web-based E-Claims entered directly into NHIA system

NHIA receives claims

NHIA district offices (around 165)

NHIA Claims Processing Centres (4 in total)

Fulfilment

Confirm volume and value of claims received

Paper claims: manual

Vetting

Adjudicate claims*

Paper claims: manual

Data entry

Collating and documenting all adjustments from fulfilment and vetting

Paper claims: manual

Generate vetting report

Report sent to both CEO's office and providers

Paper claims: manual

Initiate payment request

Paper claims: manual

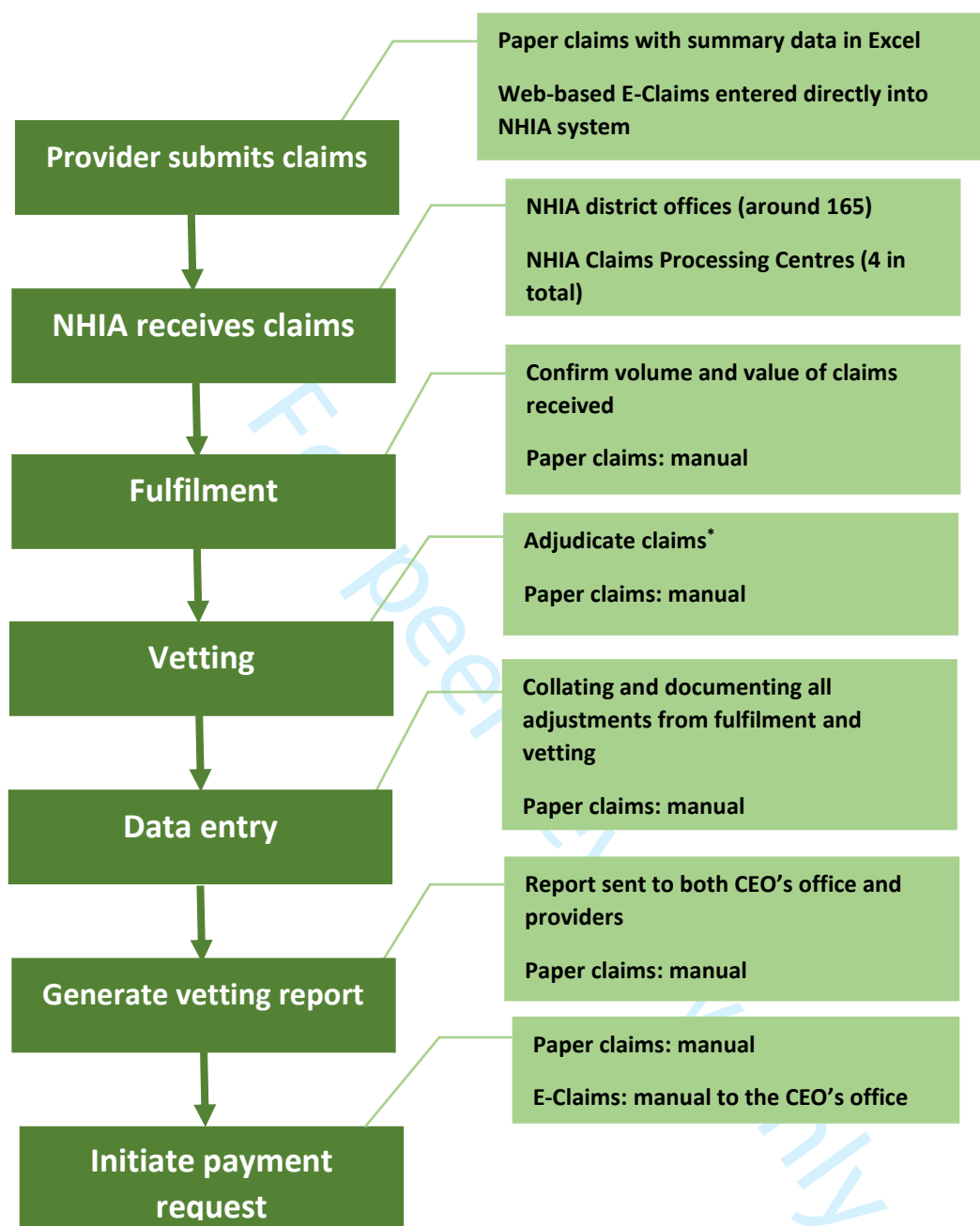**E-Claims: manual to the CEO's office**

Figure 1: Claims processing flowchart at the National Health Insurance Authority

Source: Authors' construct based on interviews with NHIA staff

Consolidated Health Economic Evaluation Reporting Standards – CHEERS Checklist 1

CHEERS Checklist

Items to include when reporting economic evaluations of health interventions

The **ISPOR CHEERS Task Force Report**, *Consolidated Health Economic Evaluation Reporting Standards (CHEERS)—Explanation and Elaboration: A Report of the ISPOR Health Economic Evaluations Publication Guidelines Good Reporting Practices Task Force*, provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp

Section	Item No	Recommendation	Reported on page No/line No
Title and Abstract			
Title	1	Identify the study as an economic evaluation or use more specific terms such as "cost-effectiveness analysis", and describe the interventions compared.	1
Abstract	2	Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions.	2
Introduction			
Background and objectives	3	Provide an explicit statement of the broader context for the study. Present the study question and its relevance for health policy or practice decisions.	3-4
Methods			
Target population and subgroups	4	Describe characteristics of the base case population and subgroups analysed, including why they were chosen.	4
Setting and location	5	State relevant aspects of the system(s) in which the decision(s) need(s) to be made.	4
Study perspective	6	Describe the perspective of the study and relate this to the costs being evaluated.	5
Comparators	7	Describe the interventions or strategies being compared and state why they were chosen.	5-6
Time horizon	8	State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate.	6
Discount rate	9	Report the choice of discount rate(s) used for costs and outcomes and say why appropriate.	7
Choice of health outcomes	10	Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed.	7
Measurement of effectiveness	11a	*Single study-based estimates*: Describe fully the design features of the single effectiveness study and why the single	8

Consolidated Health Economic Evaluation Reporting Standards – CHEERS Checklist 2

		study was a sufficient source of clinical effectiveness data.	
	11b	*Synthesis-based estimates*: Describe fully the methods used for identification of included studies and synthesis of clinical effectiveness data.	9
Measurement and valuation of preference based outcomes	12	If applicable, describe the population and methods used to elicit preferences for outcomes.	n.a
Estimating resources and costs	13a	*Single study-based economic evaluation*: Describe approaches used to estimate resource use associated with the alternative interventions. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	6
	13b	*Model-based economic evaluation*: Describe approaches and data sources used to estimate resource use associated with model health states. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	n.a
Currency, price date, and conversion	14	Report the dates of the estimated resource quantities and unit costs. Describe methods for adjusting estimated unit costs to the year of reported costs if necessary. Describe methods for converting costs into a common currency base and the exchange rate.	7
Choice of model	15	Describe and give reasons for the specific type of decision-analytical model used. Providing a figure to show model structure is strongly recommended.	5-6
Assumptions	16	Describe all structural or other assumptions underpinning the decision-analytical model.	n.a
Analytical methods	17	Describe all analytical methods supporting the evaluation. This could include methods for dealing with skewed, missing, or censored data; extrapolation methods; methods for pooling data; approaches to validate or make adjustments (such as half cycle corrections) to a model; and methods for handling population heterogeneity and uncertainty.	n.a
Results			
Study parameters	18	Report the values, ranges, references, and, if used, probability distributions for all parameters. Report reasons or sources for distributions used to represent uncertainty where appropriate. Providing a table to show the input values is strongly recommended.	n.a
Incremental costs and outcomes	19	For each intervention, report mean values for the main categories of estimated costs and outcomes of interest, as well as mean differences between the comparator groups. If	9-10

		applicable, report incremental cost-effectiveness ratios.	

Characterizing uncertainty	20a	*Single study-based economic evaluation*: Describe the effects of sampling uncertainty for the estimated incremental cost and incremental effectiveness parameters, together with the impact of methodological assumptions (such as discount rate, study perspective).	**13-15**
	20b	*Model-based economic evaluation*: Describe the effects on the results of uncertainty for all input parameters, and uncertainty related to the structure of the model and assumptions.	n.a
Characterizing heterogeneity	21	If applicable, report differences in costs, outcomes, or cost-effectiveness that can be explained by variations between subgroups of patients with different baseline characteristics or other observed variability in effects that are not reducible by more information.	15
Discussion			
Study findings, limitations, generalizability, and current knowledge	22	Summarise key study findings and describe how they support the conclusions reached. Discuss limitations and the generalisability of the findings and how the findings fit with current knowledge.	16-17
Other			
Source of funding	23	Describe how the study was funded and the role of the funder in the identification, design, conduct, and reporting of the analysis. Describe other non-monetary sources of support.	19
Conflicts of interest	24	Describe any potential for conflict of interest of study contributors in accordance with journal policy. In the absence of a journal policy, we recommend authors comply with International Committee of Medical Journal Editors recommendations.	19

For consistency, the CHEERS Statement checklist format is based on the format of the CONSORT statement checklist

The **ISPOR CHEERS Task Force Report** provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* link or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp

The citation for the CHEERS Task Force Report is:
Husereau D, Drummond M, Petrou S, et al. Consolidated health economic evaluation reporting standards (CHEERS)—Explanation and elaboration: A report of the ISPOR health economic evaluations publication guidelines good reporting practices task force. Value Health 2013;16:231-50.

Benefit cost analysis of electronic claims processing under Ghana's National Health Insurance Scheme

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-054757.R2
Article Type:	Original research
Date Submitted by the Author:	06-Apr-2022
Complete List of Authors:	Nonvignon, Justice; University of Ghana School of Public Health, Department of Health Policy, Planning and Management Addo, Rebecca; University of Technology Sydney, Centre for Health Economics Research and Evaluation (CHERE) Wang, Huihui; World Bank Group Seddoh, Anthony ; World Bank Group
Primary Subject Heading:	Health economics
Secondary Subject Heading:	Health economics, Health informatics, Health policy, Health services research, Public health
Keywords:	HEALTH ECONOMICS, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

SCHOLARONE™
Manuscripts

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

Benefit cost analysis of electronic claims processing under Ghana's National Health Insurance Scheme

Justice Nonvignon[1]*, Rebecca Addo[2], Huihui Wang[3], Anthony Seddoh[4]

[1]Department of Health Policy, Planning and Management, School of Public Health, College of Health Sciences, University of Ghana, P. O. Box LG13, Legon, Ghana
[2]Centre for Health Economics Research and Evaluation (CHERE), University of Technology Sydney, Australia
[3]The World Bank Group, Ghana, Accra, Ghana
[4]The World Bank Group, Washington, D.C, United States of America

*Corresponding author's email address: jnonvignon@ug.edu.gh

ABSTRACT

Objective: The aim of this study was to evaluate the benefit-cost of E-claims. A benefit-cost analysis was used to evaluate the efficiency of E-claims from the perspective of the providers and the purchaser.

Design: A benefit-cost analysis approach was taken for this economic evaluation. Further, we estimated the incremental benefit-cost ratio (IBCR) of the intervention under assessment.

Participants: Purchasers and healthcare providers of the NHIS of Ghana were the study population

Results: The analysis was stratified according to providers and purchaser. Cost incurred in processing claims electronically and manually were estimated by assessing the resource use and their corresponding costs. Sensitivity analysis was conducted to assess the robustness of the results to variations in discount rate and proportions of claims processed under E-claims compared to paper claims. The combined sample of providers and purchaser made incremental gains from processing claims electronically. The IBCR was -19.75, 25.56 and 5.10 for all (sample) providers, purchaser and both providers and purchaser, respectively. When projected for the 330 facilities submitting claims to the NHIS CPC as at December 2014, the IBCR were -35.20, 25.56 and 90.06 for all providers, purchaser and both providers and purchaser. The results were sensitive to the discount rate used and proportions of E-claims compared to paper claims.

Conclusion: Electronic processing of claims is more efficient compared to manual processing, hence provide an economic case for scaling it up to cover many more healthcare facilities and NHIS CPCs in the Ghana.

Strengths and limitations of this study

- The study provides evidence for scaling up of the E-claims system which improves the efficiency of the NHIS compared to the manual processing of claims

- This study addressed important gaps in knowledge about electronic processing and manual processing of insurance claims in a resource-constraint setting.

- There are difficulties in quantifying some of the benefits of the E-claims into monetary terms, reflecting methodological challenges with cost-benefit analysis.

- There is little evidence available regarding the use of electronic claims processing that provides a comparison to Ghana, therefore, it was difficult to identify similar studies

BACKGROUND

Prior to the establishment of Ghana's National Health Insurance Scheme (NHIS) in 2003, the health financing system in Ghana was characterized by high out-of-pocket (OOP) payment at the point of service, low private health insurance penetration and few community-based health insurance schemes (CBHIS). Previous studies have provided a comprehensive historical overview of health financing in Ghana [1], and other contexts of the NHIS [2-4]. Other studies explored provider payment mechanisms and sustainability of expenditure under the NHIS [5-11].

The main objective of the NHIS as contained in the Act 650 establishing it (and later Act 852 2012) was "to secure the provision of basic healthcare services to persons resident in the country" [12]. The NHIS is mainly financed by value-added tax and Social Security National Insurance Trust (SSNIT) deductions, covering 95% of the disease conditions afflicting the population. A Free Maternal and Child Care policy was also introduced in 2008 with support from the British Government [8] to accelerate attainment of MDG 4 and 5, under which antenatal, delivery and post-natal care services to pregnant women were made free to clients [5]. Faced with a number of issues around governance and operations, legalities and definition of exempt groups, the National Health Insurance Act, 2012 (Act 852) was passed in 2012 [12] replacing Act 650. By the end of 2014, the NHIS had a total active membership of 10,545,428 representing 39% of the total population of Ghana [13].

Since its implementation in 2004, the NHIA, the regulator of the NHIS, has used various provider payment mechanisms (PPMs) to reimburse health service providers for use of services by NHIS members. At the start of the implementation in 2004, itemized billing with no standard fee schedule was used to reimburse providers for services and medicines. Under this PPM, providers negotiated reimbursement rates with the NHIS office at the district level. In 2008, the Ghana-Diagnostic Related Grouping (G-DRG) payment mechanism was introduced to address challenges such as the inability of healthcare providers to code claims properly (resulting in the submission of incomplete claims); escalating costs due to spurious claims; and the lack of a system to monitor fraud. The G-DRG was used to pay for services and procedures while payment for medicines was made using standardized itemized fees (fee-for-service) based on a medicines list [5 7]. Under the G-DRG payment system, facilities submit claim forms filled for each outpatient visit and inpatient episode (coded under G-DRG) to NHIS for reimbursement. In addition, due to continued cost escalation, some of which has been attributed to fraud and moral hazards [14], per capita (capitation) payment mechanism for primary health care services was introduced in 2012. This was piloted in the Ashanti region [5 7] and was scaled up to two additional regions but was halted in 2017.

In the search of a more efficient method of reimbursing providers while financially sustaining the NHIS, the electronic claims (E-claims) processing was introduced in 2013 [11]. This initiative was part of the World Bank-supported health Insurance Project (HIP) whose main objective was to create an enabling environment for the scheme and facilitate its financial and operations management. The E-claims processing was piloted in 29 health facilities (providers) by the end of the project in March 2014. In 2019, the E-claims covered 120 healthcare facilities across the country and received a quarter of total volumes of claims submitted to National Health Insurance Authority (NHIA), the purchaser.

Description of E-Claims system

E-Claims refers to any claim that is captured on a CD, Memory stick, on-line real time, through a Web Front End model or through Health Management Information System. The purpose of introducing electronic claims was to

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

minimize the extent of human interference in the claims adjudication process, minimize errors association in claims processing from the healthcare provider end and its adjudication process at the NHIA. At the insurance side, a national Claims Processing Centre (CPC) was equipped to process electronic claims from providers across the country. At the service provider side, 29 health facilities were initially selected to submit claims through two options: 1) an XML (Extensible Markup Language) interface that transmits claim information from the provider's HMIS and electronic health record system (EHRS), and 2) Web-based tool for entering and submitting claim information. These claims are submitted to the purchaser, the NHIA' CPC in Accra, where they are equipped to electronically vet and process the E-claims submitted by providers. Under Paper-claims system, on the other hand, providers fill out claims forms per patient and submit all the forms compiled over a period to the purchaser for reimbursement.

In terms of claims processing, both E-claims and Paper-claims systems follow the same steps to process claims for reimbursement. For instance, at the purchaser side, once the CPC receives claims from the providers, they confirm the volume and value of the claims received. Afterwards, the claims are vetted to assess providers' adherence to eligibility, benefit package, Ministry of Health (MOH) treatment protocols, diagnosis, prescribing levels, treatment and tariffs assigned to each claim. Any deviation from the NHIS requirements are accounted for by adjusting claims submitted, after which reports are written and submitted to the providers and the Chief Executive Officer of the NHIA. The difference between the electronic and manual claims is that whereas the processing steps outlined above are automated either fully or partially under the former, the later are carried out manually. At the provider's side, once they submit the claims to the CPC either electronically or by claim forms, data are entered for the manual claims, but the remaining steps carried out by the CPC as described above. Figure 1 presents the steps involved in processing claims under the NHIS. Both processes require labour capacity to undertake entry of data into the web-interface for the E-claims and filling and compiling of forms under the manual claims. In addition to this, a provider requires a computer, UPS, sustained internet connection, staff with the appropriate skills and electricity to submit E-claims. Details of NHIA claim review and reimbursement process can be found elsewhere [9].

At the end of the pilot phase, a number of benefits were observed for the service providers, scheme managers and in the interactions between providers and scheme managers. For service providers, there were 1) cost savings with regards to operations cost by not using paper; 2) decreased rejection rate due to better quality claims; 3) decreased turn-around time for reimbursement and 4) increased fund stability. For scheme managers, there were 1) saved operation and management cost for claim processing by not using cumbersome paper-based system; 2) saved operation and management cost for clinical auditing; 3) increased capacity and efficiency to identify fraud claims; 4) increased capacity and efficiency to identify inappropriate services and improve service quality; and 5) increased capacity to provide evidence for policy making and implementation. Lastly, with regards to the benefits accrued in the interactions between providers and scheme managers, there were, 1) increased capacity to link up with digitalized membership management system, electronic insurance payment system, electronic medical records system in hospitals and health information management system and 2) improved human resource capacity to implement administration requirement of the health insurance scheme.

[Figure 1]

To demonstrate the effectiveness of E-claims over paper claims processing, Nsiah-Boateng et al.[9], used a cross-sectional study to compare the ability of E-claims and paper claims processing to detect spurious claims and reduce costs to the NHIA. The authors found that the E-claims review system had the ability to reduce cost to the NHIA more than paper claims (17% vs 4.9%). While this study demonstrates that E-claims is effective in reducing cost to the NHIA compared to paper claims processing, the costs and benefits of processing claims electronically or manually to providers and the overall health system is not known. A comprehensive economic evaluation could contribute to informed decision on which claims processing type provides value-for-money to both providers and the overall health system. Therefore, the aim of this study was to assess the costs and benefits of E-claims compared to the paper claims processing to inform policy makers, as well as fill a gap in the literature.

METHODS

Study design

A benefit-cost analysis approach was taken for this economic evaluation. BCA assesses the costs and benefits of an intervention compared to the next best alternative. Unlike other types of evaluations, BCA assesses the monetary value of the benefits [15-18]. Its theoretical foundations are from the concept of Pareto efficiency, where an additional re-allocation is acceptable only if it makes at least one person better off without making another person worse off [19]. In this study, we estimate the incremental benefit-cost ratio (IBCR) of the intervention under assessment. The IBCR in a BCA denotes the net benefit of an intervention compared to its best alternative. Therefore, using BCA, an intervention is said to be efficient compared to the next best alternative if the net benefit is positive.

Thus, this study sought to assess the efficiency of the E-claims compared to paper-claims system, and to establish if the marginal benefits of processing claims electronically at least covers its marginal cost: implying positive net benefits, or not. We report our methods and results in accordance with the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) [20].

Study population

Purchasers and healthcare providers of the NHIS of Ghana were the study population. As at December 2014, there were 330 district hospitals, eight secondary hospitals and one tertiary hospital submitting claims, out of which 29 were implementing E-claims. The purchaser selected was the claims processing centre (CPC) of the NHIS. For the purposes of this evaluation, 11 providers were purposively sampled out of a total of 29 providers implementing E-claims; four districts and five regional hospitals who were processing their claims electronically were selected based on the start dates of the E-claims system (i.e. we selected facilities that had processed E-claims for at least one year prior to evaluation); the Police hospital and the 37 Military hospital were also selected based on their experience with implementing the E- claims. Therefore, in addition to estimating the overall net benefit of E-claims processing in Ghana, the analysis was further categorised into the following subgroups; district, regional, tertiary and central processing centre. No patient level data were accessed as part of this study.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Perspective of analysis

The evaluation was conducted from the perspective of the Ghana health system to establish whether it was worthwhile for the system to invest in the E-claims by extending its coverage to all providers and NHIS processing centres.

Estimating costs

Data on resource use and their associated costs were obtained from the NHIA and providers under study. At the providers' side, annual cost data were collected – year 2012 for costs involved in processing paper claims (all facilities under study were using paper claims) and year 2014 for costs involved in E-claims processing (all facilities under study had rolled out E-claims processing fully). At the purchaser side, data was collected for only year 2014 for both the costs of processing paper claims and E-claims. This was because at the time, the CPC was processing both types of claims since not all providers had been enrolled onto the E-claims system. However, the cost data collected were disaggregated into paper and electronic claims by weighting the total claims by the proportions of E-claims and paper claims processed during 2014.

The costs information collected included capital and recurrent costs. Capital costs included the costs of installation (server and software purchase/upgrade, internet) and equipment (printers, computers, air conditioner, routers, and inverter). Recurrent costs included labour, transport, staff training, operations costs (office space/storage space rental costs, furniture) electricity bills, and stationery.

The total capital costs incurred by the providers were calculated by summing the costs attributable to each capital cost item. Further, since the start-up costs for the E-claims reflect costs of inputs spanning over more than one year, the equivalent annual cost (EAC) of capital items was derived by dividing the total capital cost (summed for all units of a given capital item) by the annualization factor. This was done to enable summation of capital costs with recurrent costs that occurred within one year. The annualization factor was derived from annuity tables using the useful life of each capital item (3 years were assigned for printers, UPS, stabilizer, router and batteries; and 5 years were assigned for other capital items including computer based on discussions with providers) and a discount rate of 3%, as recommended for the conduct of economic evaluation in low middle income countries [21-23]. Thus, the total capital cost (for E-Claims and paper claims) for a provider was derived by summing the EACs for all capital inputs.

The total cost incurred by the provider for each recurrent item was also calculated by multiplying the unit costs by quantity. Total recurrent cost was calculated by summing the recurrent costs that providers attributed to recurrent items they used in processing both E-Claims and paper claims. Data on the number of staff under each staff category involved in processing claims (E-Claims and paper claims) for each provider together with the proportion of time that each staff spends per month on claims processing and the gross monthly salary of each staff were collected. The labour cost per staff attributable to claim processing was calculated by multiplying the total monthly gross salary by the proportion of time spent. This was summed over one year and across staff categories to derive the total labour costs, which were then added to the recurrent costs. The costs of the paper claims were converted into 2014 estimates: base year of analysis, using the consumer price indices (CPIs) for health goods collected from the Ghana Statistical Service [24]. The total costs per providers were estimated by summing capital and recurrent costs. Cost per claim processed under each type of claims processing were derived by dividing the total costs by the total number of claims processed.

From the purchaser's side, the total operational costs (i.e. excluding capital and other investment costs) of the NHIA for 2014 was collected and used to apportion operational costs to the CPC based on the proportion of staff in the CPC as compared with the total number of staff of NHIA. The assumption here is that the proportion of staff reflects the proportion of not only staff time but also other operational expenses that could be attributed to the activities of the CPC. This was done as it was difficult to disaggregate specific cost items for the CPC. Once the operational costs attributable to CPC was derived, the proportion of E-Claims or paper claims processed by the CPC was used to apportion the CPC operational costs to either E-Claims or paper claims. Then, the cost per claim was derived by dividing the total costs of E-Claims/paper claims by the total volume/number of such claims processed by the CPC. The cost analysis was performed in Ghana Cedis (GHS) and converted into United States Dollars (US$) using the US$-GHS exchange rate for June 30, 2014 (3.00) accessed from www.xe.com. The choice of cost parameters was based on the relevant costs incurred under both claims processing types, given the types of resources expended on various activities undertaken as part of claims processing.

Estimating benefits

The benefits of claims were assessed using: 1) volumes and values of claims reimbursed and 2) claims rejection rate. For the providers, the volumes of claims were the total number of claims submitted for reimbursement. Subsequently, the values of the claims were estimated as their expected payout from the NHIS. Claims rejection rate was estimated as the difference between the claims submitted for reimbursement and the actual number of claims that were reimbursed by the NHIS. In other words, the difference between the projected value claims submitted and the actual payout received from the NHIS. The claims rejection rate was estimated for each month and that for the one-year period estimated as the average rejection rate per month for year 2012 and 2014 for paper claims and E-claims respectively.

Therefore, benefits of E-claims and paper claims per provider was estimated as the difference between the value of the submitted claims and the value of claims reimbursed (accounting for claims rejection rate). The value per claim submitted per provider was calculated by dividing the total value of claims submitted by the total volume of claims submitted.

On the other hand, the benefits of either types of claims processing to the purchaser (NHIA CPC) was estimated as the costs saved from the payouts that were not made due to rejection of submitted claims from providers. Thus, they were calculated as the cost due to rejected claims; that is, the difference between the expected payout for claims submitted by providers and the actual payout made after adjusting for claims rejected. The choice of benefit parameters was based on realistic availability of data from both providers and the purchaser.

Estimating incremental benefit-cost ratios

Incremental costs were calculated as a difference between the cost of E-claims and paper claims. The incremental benefits were calculated as the difference between the benefits of the E-claims and paper claims (Table 1). The incremental benefit-cost ratios (IBCRs), a measure of efficiency, were therefore estimated for each provider and CPC (or purchaser) by dividing incremental benefits ($B_{\text{E-claims}}$-$B_{\text{paper claims}}$) by incremental costs ($C_{\text{E-claims}}$-$C_{\text{paper claims}}$). The IBCR per specific unit (that is provider or purchaser) determines the efficiency of that unit. An IBCR greater than 1 indicates that the additional benefits of E-claims outweigh the additional costs. The IBCR was calculated for each provider, provider type (i.e. district/regional/teaching hospital), purchaser and the entire health system (that is, both providers and purchaser). The analysis for provider type used the average costs and benefits

of each provider type (i.e. summing for all units in the specific provider type within the study sample and dividing by the number of units). The analysis for the health system was done by adding the costs and benefits of all providers and purchaser and estimating their IBCR.

Furthermore, the analysis was extended to cover total number of providers (by type) projected to submit claims to the CPC as at December 2014. It is worthy to note that 91% of these facilities were not processing their claims electronically at the time of data collection. The costs and benefits were calculated by multiplying the average costs and benefits of providers (according to type) to the total number of providers using E-claims at the time of evaluation. There was only one E-claims processing centre for the NHIA as at 2014.

Table 1: Detailed calculation formulas

Estimating costs	
Provider	
Total costs	Total Recurrent costs + Total capital costs
Capital costs	Sum of equivalent annual cost of capital
Equivalent annual capital cost	Current cost of capital / annualization factor
Recurrent cost	Unit cost * quantity for each item
Purchaser	
Total operational cost of CPC	Total operational cost of NHIA * proportion of CPC staff to total staff
Operational cost of e-Claims or Paper claims	Total CPC operational cost * proportion of staff processing e-claims or paper claims
Estimating benefits	
Provider	
Benefits of e-Claims or paper claims	Total value of submitted – total value of reimbursed claims
Purchaser	
Cost savings	Expected payouts from submitted claims – actual payout/reimbursement
Incremental benefit-cost ratio	
Incremental cost	Total cost of e-claims – Total cost of paper claims
Incremental benefit	Total benefit of e-claims – Total benefit of paper claims
IBCR	Incremental benefit / incremental cost

Sensitivity analysis

Some key parameters of the study were varied to ascertain the robustness of the IBCRs estimates. A univariate sensitivity analysis was conducted on the discount rate and the proportions of claims processed under E-claims

compared to paper claims. The discount rates were varied within a range of 0% to 10%, excluding 3%, the base case.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting or dissemination plans of our research.

RESULTS

Costs of processing E-claims and Paper claims

Table 2 presents the costs per claim for the two processing types for the study population: providers and purchaser. The average cost per E-claim for the providers was US$0.65, US$0.93 and US$1.95 for the district, regional and tertiary hospitals respectively. The providers also incurred an average cost per paper claim of US$0.30, US$1.16, and US$2.26 for the district, regional and tertiary hospitals respectively. The total cost per claim for all providers was US$10.18 and US$10.45 for E-claims and paper claims respectively. Among the providers, the cost of processing[1] both electronic and paper claims were highest among tertiary hospitals. In addition, Volta regional hospital spent the highest cost in processing E-claims followed by La General Hospital. Conversely, Atebubu hospital incurred the least cost in processing E-claims. In processing paper claims, Volta regional hospital incurred the highest cost followed 37 Military hospital. Takoradi hospital spent the least in processing paper claims. The purchaser; NHIS CPC incurred US$0.59 for processing each E-claim and US$0.50 for processing each paper claim at the CPC.

Recurrent costs accounted for a higher percentage of the costs of processing both E-claims and paper claims for providers and purchasers alike. For example, for district hospitals recurrent costs constituted 86% of E-claims processing costs and 96% of paper claims processing costs (see additional file for detailed description). The main driver of the recurrent cost was labour, followed by maintenance. It is worthy to note that start-up cost of E-claims contributed to 13.6%, 8.7%, 8.3% of the overall costs for district, regional and tertiary hospitals respectively. Cost of labour also accounted for 50-76% of costs of E-claims and 59-83% of costs of paper claims.

The incremental cost for all providers was estimated at US$-0.27 and that for the purchaser (CPC of the NHIA) was US$0.09. When stratified by types of providers, the average incremental cost per E-claim per district, regional and tertiary hospitals were US$0.35, US$-0.23, and US$-0.31 respectively.

---

[1] The cost of processing claims includes all costs incurred from preparing and submitting claims

Table 2: Estimated costs of processing E-claims and paper claims by healthcare providers and purchaser, 2014

Study population	Cost per claim (US$)		Incremental cost (US$)
	E-claims	Paper claims	
Providers			
District			
Atebubu hospital	0.27	0.22	0.05
St. Martins hospital	0.59	0.29	0.3
Takoradi hospital	0.29	0.12	0.17
La general hospital	1.46	0.57	0.89
Average District	*0.65*	*0.30*	*0.35*
Total district	*2.61*	*1.2*	*1.41*
Regional			
Sunyani hospital	0.90	0.29	0.61
Koforidua hospital	0.61	1.25	(0.64)
Ridge hospital	0.81	0.32	0.49
Police hospital	0.74	1.95	(1.21)
Volta hospital	2.00	2.60	(0.60)
Effia Nkwanta hospital	0.56	0.58	(0.02)
Average Region	*0.94*	*1.17*	*(0.23)*
Total region	*5.62*	*6.99*	*(1.37)*
Tertiary			
37 Military hospital	1.95	2.26	(0.31)
All providers			
Average	0.93	0.95	(0.02)
Total	10.18	10.45	(0.27)
Purchaser			
CPC	0.59	0.50	0.09
Health system (All providers and Purchaser)			
Average	0.90	0.91	(0.01)
Total	10.77	10.95	(0.18)

Note:

All costs were estimated in 2014. A conversion rate of GHC3.00 per US$1 was used.

Abbreviation: CPC; claims processing centre, E-claims; electronic claims

Benefits of processing E-claims and paper claims

Table 3 presents the benefits of E-claims and paper claims to the healthcare providers and the purchaser (NHIA). The average value per E-claim without errors (that is expected payout) for the providers was US$9.29, US$14.96 and US$114.31 for the district, regional and tertiary hospitals respectively. The average value per paper claim without errors was US$8.22, US$13.87 and US$18.26 for the district, regional and tertiary hospitals

respectively. When put together, all providers were expected to gain US$128.31 per E-claim and US$125.52 per paper claim as claims payout.

The NHIA expected payout for processing claims electronically and manually were US$11.26 and US$9.71 per claim respectively. However, after correcting for errors, they paid out US$11.03 per E-claim submitted and US$ 8.74 per paper claim submitted by providers, hence making a cost savings (benefits) of US$ 0.23 and US$ 0.97 for each electronic and paper claim submitted by providers respectively.

The average rejection rates for E-claims versus paper claims were 3% (0.001% - 10%) vs 10% for the district hospitals, 1% vs 6 for regional hospitals, 0% vs. 6% for tertiary hospital, 2% vs 10% NHIA respectively. The highest rejection rate was seen among paper processing of claims for both providers and purchaser.

The average incremental benefits per E-claim were US$1.07 for district hospitals, US$1.07 for regional hospitals, US$-3.94 for tertiary hospital and US$-0.75 for CPC. Overall, the incremental benefit for all providers was estimated at US$10.72 and purchaser and providers was US$ 9.97 per E-claim.

Table 3: Estimated benefits of E-claims and Paper claims by providers and purchaser, 2014

Study population	Value per claim submitted		Rejection rate (%)		Value per claim reimbursed (US$) (accounting for rejection rate)		Incremental benefits (US$)
	E-claims	Paper claims	E-claims	Paper claims	E-claims	Paper claims	
Providers							
District							
Atebubu hospital	9.06	8.82	10.00	20.00	8.16	7.05	1.10
St. Martins hospital	9.81	12.42	0.00	5.00	9.81	11.80	(1.99)
Takoradi hospital	9.07	4.65	0.10	0.10	9.06	4.64	4.42
La general hospital	10.15	9.67	0.00	3.00	10.15	9.38	0.77
Average District	*9.52*	*8.89*	*-*	*-*	*9.29*	*8.22*	*1.07*
Total district	*38.08*	*35.55*	*-*	*-*	*37.17*	*32.87*	*4.29*
Regional	0.00	0.00					
Sunyani hospital	15.94	14.51	2.40	3.00	15.56	14.08	1.48
Koforidua hospital	16.62	15.13	-	12.50	16.62	13.24	3.38
Ridge hospital	17.06	14.21	0.30	3.00	17.01	13.78	3.22
Police hospital	12.58	14.53	0.50	15.00	12.52	12.35	0.17
Volta hospital	12.98	16.44	-	0.00	12.98	16.44	-3.46
Effia Nkwanta hospital	15.05	15.15	0.60	12.00	14.96	13.33	1.63
Average Region	*15.04*	*15.00*	*-*	*-*	*14.96*	*13.87*	*1.07*
Total region	*90.23*	*89.97*	*-*	*-*	*89.64*	*83.22*	*6.42*
Tertiary							

Study population	Value per claim submitted		Rejection rate (%)		Value per claim reimbursed (US$) (accounting for rejection rate)		Incremental benefits (US$)
	E-claims	Paper claims	E-claims	Paper claims	E-claims	Paper claims	
37 Military hospital	14.31	19.48	-	6.30	14.31	18.26	(3.94)
All providers							
Average	11.66	11.41	-	-	11.55	10.50	0.97
Total	128.31	125.52	-	-	126.81	116.09	6.77
Purchaser							
CPC (NHIA)	11.26	9.71	2.00	10.00	0.23	0.97	(0.75)
Health system (All providers and purchaser)							
Average	11.63	11.27	-	-	10.59	9.76	0.83
Total	139.58	135.23	-	-	127.04	117.07	6.03

Note: All costs were estimated in 2014. A conversion rate of GHC3.00 per US$1 was used.

Abbreviation: CPC; claims processing centre, E-claims; electronic claims

Incremental benefit cost ratio of processing E-claims and paper claims

Table 4 presents a summary of the incremental benefit-cost ratios (IBCRs) by study population (study units). The IBCR was 3.05 for district hospitals, -4.69 for regional hospitals, 12.72 for tertiary hospital and -8.28 for CPC. Two out of four district hospitals recorded IBCRs of less than one: St Martin's hospital (-6.65) and La general hospital (0.86). Three regional hospital also had an IBCR of less than one: Koforidua regional hospital (-5.28), Police hospital (-0.14) and Efia Nkwanta regional hospital (-81.49). The overall IBCR for all providers was -25.09 and that for the health system was -33.49.

Table 4: Incremental benefit-cost ratio of processing E-claims and paper claims by healthcare providers and purchaser, 2014

Study population	Incremental benefit-cost ratios
Providers	
District	
Atebubu hospital	22.07
St. Martins hospital	(6.65)
Takoradi hospital	25.97
La general hospital	0.86
Average District	*3.05*
Total district	*3.05*
Regional	
Sunyani hospital	2.43
Koforidua hospital	(5.28)
Ridge hospital	6.58
Police hospital	(0.14)
Volta hospital	5.77
Effia nkwanta hospital	(81.49)
Average Region	*(4.69)*

Total region	*(4.69)*
Tertiary	
37 Military hospital	12.72
All providers	
Average	(48.71)
Total	(25.09)
Purchaser	
CPC (NHIA)	(8.28)
Health system (All providers and purchaser)	
Average	(83.09)
Total	(33.49)

Note:

All costs were estimated in 2014. A conversion rate of GHC3.00 per US$1 was used.

Abbreviation: CPC; claims processing centre, E-claims; electronic claims

Values in parenthesis denote negative values

Table 5 further presents the IBCR of all providers nationwide submitting claims to the NHIS CPC as at the end of 2014. The IBCR extrapolated for providers and purchaser nationwide were 3.05 for district hospitals, -4.69 for regional hospitals, 12.72 for tertiary hospitals and -8.28 for the CPC. IBCR for all providers nationwide was 11.08 and the entire health system was 2.79.

Table 5: Extrapolated IBCR for all providers submitting claims to the NHIA CPC as at the end of year 2014

Study population	Incremental cost (US$)	Incremental benefits (US$)	IBCR
^Providers			
All district hospitals	347.98	1706.80	4.90
All regional hospitals	(231.64)	764.98	(3.30)
Tertiary hospitals	(307.18)	(3953.13)	12.87
All providers	***(63.61)***	***2239.18***	***(35.20)***
Purchaser			
CPC	89.97	2300.02	25.56
Health system			
All providers and purchaser	26.36	2373.95	90.06

^Providers submitting claims to CPC by end 2014; All costs and benefits were estimated in 2014. A conversion rate of GHC3.00 per US$1 was used; Values in parenthesis denote negative values

Study population	Incremental cost (US$)	Incremental benefits (US$)	IBCR
***Providers**			
All district hospitals	116.33	354.31	3.05
All regional hospitals	(1.83)	8.56	(4.69)
Tertiary hospitals	(0.31)	(3.94)	12.72
All providers			
Average	(91.53)	3633.04	(39.69)

Study population	Incremental cost (US$)	Incremental benefits (US$)	IBCR
Total	*114.19*	*358.93*	*11.08*
Purchaser			
CPC	0.09	(0.75)	(8.28)
Health system (All providers and purchaser)			
Average	(3.4)	282.52	(83.09)
Total	*114.28*	*358.18*	*2.79*

*All providers nationwide; All costs and benefits were estimated in 2014; A conversion rate of GHC3.00 per US$1 was used; Values in parenthesis denote negative values; As at the period of data collection, there were 330 districts hospitals, eight regional hospitals, one tertiary hospital and one NHIS CPC using E-claims processing

3.4 Sensitivity analysis

The results of the sensitivity analysis showed that increasing the discount rate for both costs and benefits led to reductions in the IBCRs for each study unit and vice versa. However, this change did not influence the direction of the findings: from being efficient to not efficient and vice versa. For example, a 10% discount rate did not change the claims processing of a provider or purchaser from being profitable to unprofitable. When the proportions of E-claims to total claims were increased, the IBCR of the NHIA CPC reduced. For instance, increasing the proportion of E-Claims from the base of 29% to 50% as against 50% paper claims (from 71% at base) reduced the IBCR from 15.14 to 2.32. The analysis shows that if all claims were processed electronically, 100% the IBCR will be less than one (0.76), indicating that the incremental cost of processing additional claims exceeds incremental benefits. The CPC of NHIS can only achieve IBCR of one when 81% of claims are processed electronically and 19% processed manually. Any higher proportion of E-Claims worsens the IBCR.

DISCUSSION

Analysis of the benefits and costs of the E-claims and paper claims processing systems of the NHIA show that electronic processing of clams is more efficient than the manual system. On the average, all providers spent less cost in processing E-claims compared to paper claims. However, contrary to what was expected, the E-claims was more labour intensive. This could be attributed to providers associating efficiency of claims processing to the number of staff assigned to it: the higher the number of staff, the more efficient the processing and vice versa. Therefore, a more cost saving approach in terms of less labour under the E-claims could improve the efficiency gains by reducing the costs of processing. On the other hand, the purchaser (NHIA) spent more money to process claims electronically compared to manual system. The reason for this is not readily known but might be due to maintenance cost of the E-claims infrastructure. The E-claims set-up requires periodic repairs and upgrade by the service provide to make it more robust and efficient, and this comes with cost to the NHIA.

Generally, the healthcare providers and the purchaser (NHIA) benefit more from processing claims using the electronic system than manual one. This assertion stems from the higher rejection rates from the E-claims processing system, compared to the paper claims processing system: 7.26% versus 1.26% for all providers and

10% versus 2% for the NHIS. Higher claims rejection by E-claims implies better ability of the purchaser to detect errors in submitted claims, but it also motivates efficiency on the part of providers to complete claims forms better. These findings confirm the study by Nsiah-Boateng et al., which reported that the E-claims processing system has a higher claims rejection rate than the paper claims processing system, and concluded that the former could reduce cost to the NHIS. However, the claims rejection rates reported by our study were different from that reported by Nsiah-Boateng et al [9]. For example, while they reported an adjustment rate of 17.9% for district hospitals using E-claims, we estimated 10% claims rejection rate for district hospitals. The difference in the rejection rate size could be attributed to the different methodological approaches employed to estimate effectiveness of E-claims processing system, the number and type of facilities used for both studies, and the study period.

This study also reveals a reduction in the volumes of claims submitted by providers under the E-claims compared to the paper claims processing system. This reduction was very apparent at the district and regional hospitals. The reasons for this reduction are not clearly known but they could be attributed to healthcare providers' knowledge of the ability of the electronic claims processing to streamline claims and reduce the number of spurious claims submitted to the purchaser, NHIA.

Overall, an important implication of the findings of this study for policy is that the electronic processing of claims for reimbursement is efficient from the health system payer's (purchaser). Therefore, E-claims has the potential to reduce costs to the insurance system overall. In addition, E-claims improves claims processing times from both provider and insurance perspectives, with potential improvement in quality. Moreover, providers are making incremental gains from processing claims electronically compared to the manual system. The additional costs incurred from E-claims could be attributed to high start-up cost and labour cost. Therefore, it is anticipated that, when evaluated over a period of more than one year, these costs could reduce further.

It is important to note that for this study, benefits data used was claims rejection rates, which were applied on volumes and values of claims reimbursed to providers by the NHIA. Nevertheless, other important benefits of the E-Claim system are worth mentioning. An essential benefit of E-Claims over paper claim is that E-Claims ensures that providers tend to rely on the stability of funds from the NHIS after providing services for clients. Furthermore, E-Claims reduces the time between claims submission and reimbursement as reported by both NHIS staff and providers involved in this study. On the insurance side, there are savings on cost of operation and management of claims. The electronic system also provides a platform to identify actions of providers that lead to fraud in the system. On both the insurance (payer/purchaser) and provider sides, the electronic system improves the capacity to manage claims.

Study limitations

The study findings notwithstanding, some limitations are worth mentioning. First, difficulties in quantifying some of the benefits of the E-claims into monetary terms, for example as discussed in the previous paragraph. Thus, methodological challenges with cost-benefit analysis hinder the use of some of the benefits in a cost-benefit analysis [15-18]. It is important to note the possibility of under-estimation of the IBCRs reported in this study with the exclusion of such key benefits of electronic claims processing. With the advancement in the methods for efficiency analysis, it will be possible to measure and incorporate indicators such as fraud,

predictability in funds, and turnaround time in the estimation of the efficiency of electronic claims in the foreseeable future. Second, with Ghana's NHIS being one of first country-level social health insurance policies in sub-Saharan Africa, there is little evidence elsewhere regarding the use of electronic claims processing that provides a comparison to Ghana, therefore, it is difficult to identify studies assessing the comparative benefits and costs of electronic versus paper claims processing for a national health insurance programme.

CONCLUSION

The findings of this study show that the E-claims processing system is the economically preferred alternative to the paper claims. The study reinforces the recommendation of an earlier study on the scaling up of the E-claims system, even though for different reasons. Processing claims electronically improves the efficiency of the NHIS and reduces the number of claims rejected for payment on both the providers and the NHIA side, therefore, increasing their benefits compared to the manual processing of claims. However, to attain efficiency from the providers' side, the number of personnel assigned to E-claims processing would have to be reduced.

Figure 1: Claims processing flow chart at the National health Insurance Authority

Competing interests
JN received consultancy fees to undertake the study. ATS and WH are both employees of the funder. RA declares no competing interest.

Data availability statement
The dataset analysed during the current study are available from the corresponding author on reasonable request.

Patient consent for publication: Not required

Ethics approval:
Permission for the study was obtained from the National Health Insurance Authority (NHIA).

Contributors
JN and WH conceived the study. JN designed the study, collected and analyzed data. JN and RA prepared the first draft of the manuscript. WH and ATS reviewed and provided substantial comments to first draft. All authors read and approved the final manuscript.

References

1. Agyepong IA, Adjei S. Public social policy development and implementation: a case study of the Ghana National Health Insurance scheme. *Health Policy Plan* 2008;23(2):150-60. doi: 10.1093/heapol/czn002 [published Online First: 2008/02/05]

2. Ansah EK, Narh-Bana S, Asiamah S, et al. Effect of Removing Direct Payment for Health Care on Utilisation and Health Outcomes in Ghanaian Children: A Randomised Controlled Trial. *PLOS Medicine* 2009;6(1):e1000007. doi: 10.1371/journal.pmed.1000007

3. McIntyre D, Garshong B, Mtei G, et al. Beyond fragmentation and towards universal coverage: insights from Ghana, South Africa and the United Republic of Tanzania. *Bulletin of the World Health Organization* 2008;86(11):871-6. doi: 10.2471/blt.08.053413 [published Online First: 2008/11/26]

4. Witter S, Garshong B. Something old or something new? Social health insurance in Ghana. *BMC International Health and Human Rights* 2009;9(1):20. doi: 10.1186/1472-698X-9-20

5. Agyepong IA, Aryeetey GC, Nonvignon J, et al. Advancing the application of systems thinking in health: provider payment and service supply behaviour and incentives in the Ghana National Health Insurance Scheme--a systems approach. *Health research policy and systems* 2014;12:35. doi: 10.1186/1478-4505-12-35 [published Online First: 2014/08/07]

6. Alhassan RK, Nketiah-Amponsah E, Arhinful DK. A Review of the National Health Insurance Scheme in Ghana: What Are the Sustainability Threats and Prospects? *PLoS One* 2016;11(11):e0165151. doi: 10.1371/journal.pone.0165151 [published Online First: 2016/11/11]

7. Andoh-Adjei F-X, Nsiah-Boateng E, Asante FA, et al. Provider preference for payment method under a national health insurance scheme: A survey of health insurance-credentialed health care providers in Ghana. *PLOS ONE* 2019;14(8):e0221195. doi: 10.1371/journal.pone.0221195

8. Ankrah Odame E, Akweongo P, Yankah B, et al. Sustainability of recurrent expenditure on public social welfare programmes: expenditure analysis of the free maternal care programme of the Ghana National Health Insurance Scheme. *Health Policy and Planning* 2013;29(3):271-79. doi: 10.1093/heapol/czt013

9. Nsiah-Boateng E, Asenso-Boadi F, Dsane-Selby L, et al. Reducing medical claims cost to Ghana's National Health Insurance scheme: a cross-sectional comparative assessment of the paper- and electronic-based claims reviews. *BMC health services research* 2017;17(1):115. doi: 10.1186/s12913-017-2054-1 [published Online First: 2017/02/09]

10. Sodzi-Tettey S, Aikins M, Awoonor-Williams JK, et al. Challenges in provider payment under the Ghana National Health Insurance Scheme: a case study of claims management in two districts. *Ghana Med J* 2012;46(4):189-99.

11. Wang H, Otoo N, Dsane-Selby L. Ghana National Health Insurance Scheme: improving financial sustainability based on expenditure review. World Bank Studies. Washington, DC: The World Bank, 2017.

12. National Health Insurance Act. National Health Insurance Act, 2012, 852 Sess. (2012). 2012.

13. MOH. Holistic Assessment of Health Sector Program of Work 2014. Accra, Ghana: Ministry of Health, 2015.

14. Yawson AE, Biritwum RB, Nimo PK. Effects of consumer and provider moral hazard at a municipal hospital out-patient department on Ghana's National Health Insurance Scheme. *Ghana Med J* 2012;46(4):200-10.

15. Briggs A, Claxton K, Sculpher MJ. Decision Modelling for Health Economic Evaluation. Oxford Oxford University Press 2006.

16. Drummond MF, Sculpher MJ, Claxton K, et al. Methods for the Economic Evaluation of Health Care Programmes. 4th ed. Oxford: Oxford University Press 2015.

17. Gray AM, Clarke PM, Wolstenholme JL, et al. Applied methods of cost-effectiveness analysis in healthcare. . Oxford Oxford University Press 2011.

18. Lane R, Soyemi A, Corso PS. Part IV: Benefit-Cost Analysis. Outcomes Quantified in Dollars: The Fourth of a Five-Part Series [PowerPoint Presentation].

19. Stiglitz J, E. Pareto efficient and optimal taxation and the new welfare economics. Cambridge (1050 Massachusetts Avenue, Cambridge, Mass. 02138) :National Bureau of Economic Research1987.

20. Husereau D, Drummond M, Petrou S, et al. Consolidated Health Economic Evaluation Reporting Standards (CHEERS)--explanation and elaboration: a report of the ISPOR Health Economic Evaluation Publication Guidelines Good Reporting Practices Task Force. *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research* 2013;16(2):231-50. doi: 10.1016/j.jval.2013.02.002 [published Online First: 2013/03/30]

21. Claxton KP, Revill P, Sculpher MJ, et al. The Gates Reference Case for Economic Evaluation (MEEP). London: NICE International, 2014.

22. Sanders GD, Neumann PJ, Basu A, et al. Recommendations for Conduct, Methodological Practices, and Reporting of Cost-effectiveness Analyses: Second Panel on Cost-Effectiveness in Health and Medicine. *Jama* 2016;316(10):1093-103. doi: 10.1001/jama.2016.12195 [published Online First: 2016/09/14]

23. Wilkinson T, Sculpher MJ, Claxton K, et al. The International Decision Support Initiative Reference Case for Economic Evaluation: An Aid to Thought. *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research* 2016;19(8):921-28. doi: 10.1016/j.jval.2016.04.015 [published Online First: 2016/12/19]

24. Ghana Statistical Service. Price Indices: Consumer Price Index Bulletin 2019 [Available from: https://statsghana.gov.gh/nationalaccount_macros.php?Stats=MTE2MTIyMjQ5Ni41NjY=/webstats/7163p83s71.
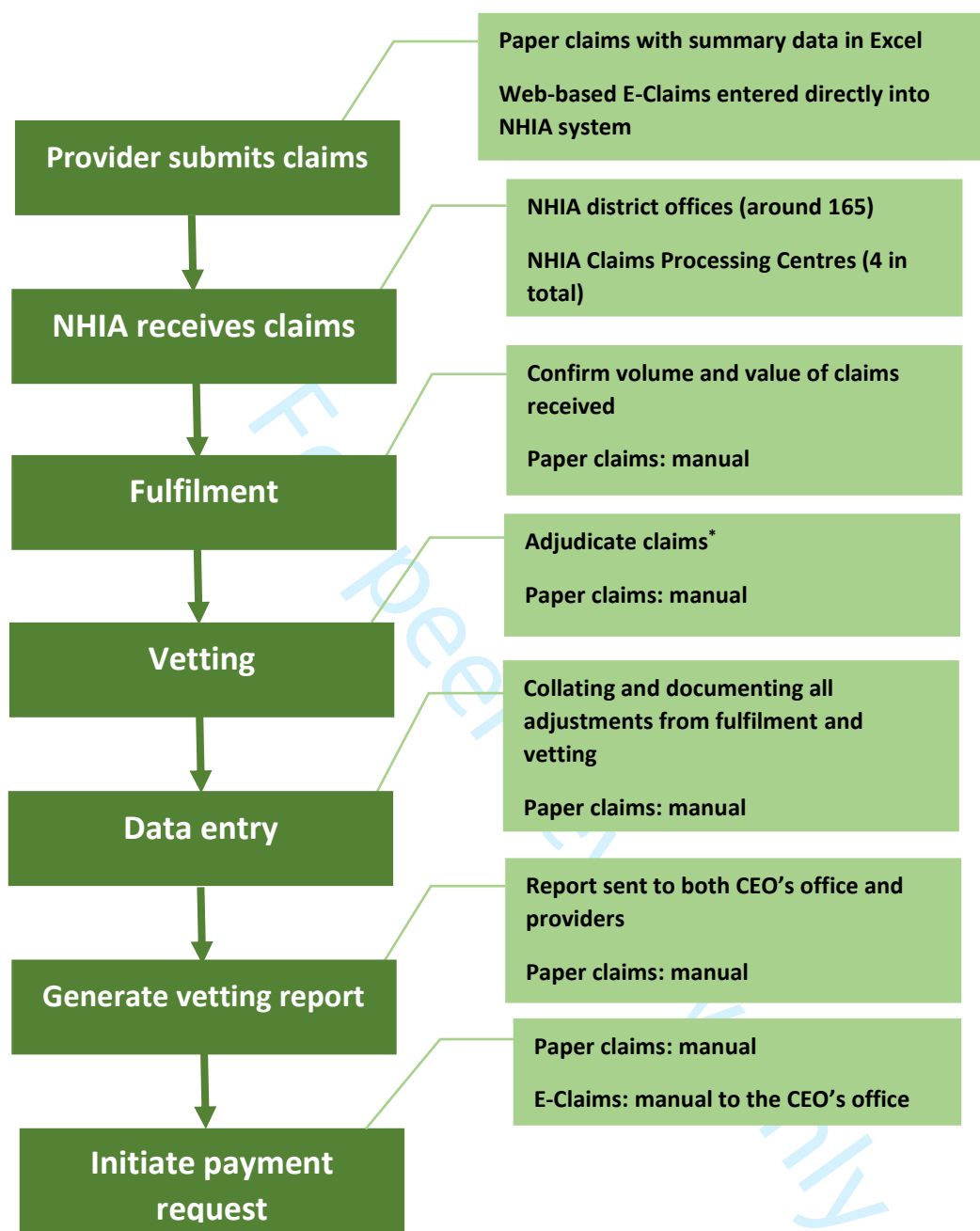
Figure 1: Claims processing flowchart at the National Health Insurance Authority

Source: Authors' construct based on interviews with NHIA staff

Consolidated Health Economic Evaluation Reporting Standards – CHEERS Checklist 1

CHEERS Checklist

Items to include when reporting economic evaluations of health interventions

The **ISPOR CHEERS Task Force Report**, *Consolidated Health Economic Evaluation Reporting Standards (CHEERS)—Explanation and Elaboration: A Report of the ISPOR Health Economic Evaluations Publication Guidelines Good Reporting Practices Task Force*, provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp

Section	Item No	Recommendation	Reported on page No/line No
Title and Abstract			
Title	1	Identify the study as an economic evaluation or use more specific terms such as "cost-effectiveness analysis", and describe the interventions compared.	1
Abstract	2	Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions.	2
Introduction			
Background and objectives	3	Provide an explicit statement of the broader context for the study. Present the study question and its relevance for health policy or practice decisions.	3-4
Methods			
Target population and subgroups	4	Describe characteristics of the base case population and subgroups analysed, including why they were chosen.	4
Setting and location	5	State relevant aspects of the system(s) in which the decision(s) need(s) to be made.	4
Study perspective	6	Describe the perspective of the study and relate this to the costs being evaluated.	5
Comparators	7	Describe the interventions or strategies being compared and state why they were chosen.	5-6
Time horizon	8	State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate.	6
Discount rate	9	Report the choice of discount rate(s) used for costs and outcomes and say why appropriate.	7
Choice of health outcomes	10	Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed.	7
Measurement of effectiveness	11a	*Single study-based estimates*: Describe fully the design features of the single effectiveness study and why the single	8

Consolidated Health Economic Evaluation Reporting Standards – CHEERS Checklist 2

		study was a sufficient source of clinical effectiveness data.	
	11b	*Synthesis-based estimates*: Describe fully the methods used for identification of included studies and synthesis of clinical effectiveness data.	9
Measurement and valuation of preference based outcomes	12	If applicable, describe the population and methods used to elicit preferences for outcomes.	n.a
Estimating resources and costs	13a	*Single study-based economic evaluation*: Describe approaches used to estimate resource use associated with the alternative interventions. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	6
	13b	*Model-based economic evaluation*: Describe approaches and data sources used to estimate resource use associated with model health states. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	n.a
Currency, price date, and conversion	14	Report the dates of the estimated resource quantities and unit costs. Describe methods for adjusting estimated unit costs to the year of reported costs if necessary. Describe methods for converting costs into a common currency base and the exchange rate.	7
Choice of model	15	Describe and give reasons for the specific type of decision-analytical model used. Providing a figure to show model structure is strongly recommended.	5-6
Assumptions	16	Describe all structural or other assumptions underpinning the decision-analytical model.	n.a
Analytical methods	17	Describe all analytical methods supporting the evaluation. This could include methods for dealing with skewed, missing, or censored data; extrapolation methods; methods for pooling data; approaches to validate or make adjustments (such as half cycle corrections) to a model; and methods for handling population heterogeneity and uncertainty.	n.a
Results			
Study parameters	18	Report the values, ranges, references, and, if used, probability distributions for all parameters. Report reasons or sources for distributions used to represent uncertainty where appropriate. Providing a table to show the input values is strongly recommended.	n.a
Incremental costs and outcomes	19	For each intervention, report mean values for the main categories of estimated costs and outcomes of interest, as well as mean differences between the comparator groups. If	9-10

Consolidated Health Economic Evaluation Reporting Standards – CHEERS Checklist 3

		applicable, report incremental cost-effectiveness ratios.	

Characterizing uncertainty	20a	*Single study-based economic evaluation*: Describe the effects of sampling uncertainty for the estimated incremental cost and incremental effectiveness parameters, together with the impact of methodological assumptions (such as discount rate, study perspective).	**13-15**
	20b	*Model-based economic evaluation*: Describe the effects on the results of uncertainty for all input parameters, and uncertainty related to the structure of the model and assumptions.	n.a
Characterizing heterogeneity	21	If applicable, report differences in costs, outcomes, or cost-effectiveness that can be explained by variations between subgroups of patients with different baseline characteristics or other observed variability in effects that are not reducible by more information.	15
Discussion			
Study findings, limitations, generalizability, and current knowledge	22	Summarise key study findings and describe how they support the conclusions reached. Discuss limitations and the generalisability of the findings and how the findings fit with current knowledge.	16-17
Other			
Source of funding	23	Describe how the study was funded and the role of the funder in the identification, design, conduct, and reporting of the analysis. Describe other non-monetary sources of support.	19
Conflicts of interest	24	Describe any potential for conflict of interest of study contributors in accordance with journal policy. In the absence of a journal policy, we recommend authors comply with International Committee of Medical Journal Editors recommendations.	19

For consistency, the CHEERS Statement checklist format is based on the format of the CONSORT statement checklist

The **ISPOR CHEERS Task Force Report** provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* link or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp

The citation for the CHEERS Task Force Report is:
Husereau D, Drummond M, Petrou S, et al. Consolidated health economic evaluation reporting standards (CHEERS)—Explanation and elaboration: A report of the ISPOR health economic evaluations publication guidelines good reporting practices task force. Value Health 2013;16:231-50.