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Introducing Risperidone for Treatment of Schizophrenia to the Essential Drug List
in Uganda: A Budget Impact Analysis

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Abstract

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Objectives

The aim of this study was to analyze the budget impact of introducing risperidone onto the essential drug list for treating schizophrenia in Uganda. Risperidone is a second-generation antipsychotic that has been shown to be cost-effective in a previous study in Uganda. More information on its potential budget impact is needed.

Methods

Budget impact analysis was used to estimate the potential cost of risperidone from the payer perspective. Data on the epidemiology of schizophrenia, drug cost, treatment effect of antipsychotics, adverse effect of antipsychotics, and prescription pattern of antipsychotics were

collected from published studies, the international drug price indicator guide, and clinical trial results.

Results

For treating 120,256 schizophrenia patients in Uganda in 2016, we calculated that the government would spend a total of \$3,083,310 for chlorpromazine with an 80% market share and haloperidol with a 20% market share. Considering an annual increase of 10% market share for risperidone, the total budget would initially rise to \$6,530,104 in 2017 and then level off to approximately \$6 million from 2018 onward. The cost per tax payer per year ranges from \$0.08 in 2016 to \$0.14 in 2020 depending on different sets of market shares of the three antipsychotics.

Conclusion

As the price for risperidone falls and less adverse effects occur due to risperidone substitution, the total budget of adding risperidone to the essential drug list is expected to rise initially and then level off. As a result, it is recommended that risperidone be added onto the essential drug list considering its cost-effectiveness and potential affordability.

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DEDICATION

To family and friends who are always there during my ups and downs.

Chapter 1. INTRODUCTION AND BACKGROUND

1.1 SCHIZOPHRENIA

Schizophrenia is a chronic and disabling mental illness caused by genetic, environmental and brain structural factors, with positive, negative, and cognitive symptoms (1). Positive symptoms refer to hallucinations, delusions, thought disorders, and movement disorders. Negative symptoms refer to lack of pleasure, social withdrawal, apathy, and emotional flatness. Cognitive symptoms involve difficulty in executive functioning and memory, along with other related domains. Schizophrenia has been classified into a number of different types: paranoid schizophrenia, disorganized schizophrenia, catatonic schizophrenia, residual schizophrenia and schizoaffective disorder. For the treatment of schizophrenia, there are primarily two generations of antipsychotics currently being used. First generation or first-line or typical antipsychotics, include chlorpromazine, haloperidol, perphenazine and fluphenazine. Second generation or second-line or atypical antipsychotics, include risperidone, olanzapine, quetiapine, ziprasidone, aripiprazole and paliperidone.

Two generations of antipsychotics agents work by connecting different dopamine receptors (D2 receptors) to reduce dopamine secretion and then relieve positive symptoms of schizophrenia (2). The most common adverse effect of typical antipsychotics is extrapyramidal symptoms (EPS) (3-5). Atypical antipsychotics are usually preferred over typical antipsychotics because they cause less EPS (6). Atypical antipsychotics work by connecting with both Dopamine and 5-hydroxytryptamine receptors (5-HT receptors) to relieve both positive and negative symptoms (7). Due to the connections with 5-HT receptors as well, atypical antipsychotics bring less EPS

compared to typical ones (8). However, atypical antipsychotics are known for their metabolic adverse effects, e.g. weight gain, hyperlipidemia, and diabetes (9, 10).

Proprietary atypical antipsychotics currently cost over ten times more than nonproprietary typical antipsychotics for a defined daily dose (DDD) (11-13). DDD is used for a comparison of drugs, budgeting purposes, and differentiation between formulary, strength, or package of a medication (11, 14). The financial burden of schizophrenia is substantial because the disease needs long-term medication therapy. Haloperidol was about 3 cents per day as of 2014 based on the latest international drug price indicator guide (11). The median price for a DDD of risperidone was about 5 cents as of 2014, a reduction from \$1 before 2008. The median prices of risperidone between 2010 and 2014 were between 5-16 cents, which was closer to the daily cost of haloperidol.

1.2 EPIDEMIOLOGY OF SCHIZOPHRENIA IN UGANDA

It was estimated that there are 29 million schizophrenia patients globally, with 20 million living in the least developed regions of the world as of 1997 (15). An estimated 1% of the Ugandan population are suffering from schizophrenia by 2014 (1). The estimated median one-year period prevalence of schizophrenia is 3.3 (10%-90% quantile, 1.3-8.2) per 1,000 based on a systematic review of 188 epidemiological studies published in 2005 (16). With no available prevalence data of schizophrenia in Uganda, the global median statistic was used in this budget impact analysis. A systematic review using studies from 33 countries estimated the global median incidence of schizophrenia to be 15.2 (10%-90% quantile, 7.7–43.0) per 100,000 in 2004 (17). This analysis uses the global median incidence to substitute the schizophrenia incidence in Uganda, which doesn't have available incidence data now. The population of Uganda in 2016 is 38.32 million,

with an annual growth rate of 3.22% (18). The epidemiological data of total population, prevalence, and incidence are used to estimate the total number of eligible patients for schizophrenia treatment in Uganda.

1.3 CURRENT TREATMENT FOR SCHIZOPHRENIA IN UGANDA

The most widely used antipsychotics are the first generation antipsychotics, in particular chlorpromazine and haloperidol, which take up 75% and 25% of the prescriptions respectively (19). The use of second generation antipsychotics is extremely rare. In the prescription pattern study of schizophrenia treatment in the largest mental health hospital in Uganda, only 2 cases out of nearly 700 patients in total were treated with risperidone (19). First generation antipsychotics are reported to have higher tendency of getting adverse effects, for instance extrapyramidal syndromes, weight gain and diabetes. The way doctors deal with side effects is to switch patients to another therapy. Patients currently on first generation antipsychotics would be switched to the second generation drugs and patients currently on the second generation antipsychotics would be under careful watch after side effects are observed.

The Essential Medicine and Health Supply List in Uganda (EMHSLU) uses the VEN classification system to define the different levels of importance for different drugs (20). Vital (V) is a level of drug classification to define medicines used to treat life-threatening diseases, while essential (E) is to define medicines used to treat widespread but less severe diseases. Necessary (N) defines medicines used to treat diseases with less impact on population (20). In the essential medicines and health supplies list for Uganda 2012, chlorpromazine, fluphenazine, haloperidol, and a few other first-line antipsychotics are classified as vital or essential (20). Risperidone is listed as

necessary in the EMHSLU 2012. The essential medicine concept helps to ensure a list of commonly-used drugs in stock for universal health coverage with a low procurement cost (21).

Randomized control trials have shown that the re-hospitalization rate when chlorpromazine is used is 30%, while that of haloperidol is 20% with risperidone having the lowest at 10% (22-25). These parameters from the Clinical Antipsychotic Trials of Intervention Effectiveness (CAITIE) are used to estimate the hospitalization costs for the three antipsychotics. The probabilities of having EPS for chlorpromazine, haloperidol, and risperidone are WHO recommended in a guideline that second generation antipsychotics should be considered over typical antipsychotic if there are no cost and availability constraints (26). The reasons often provided as to why second generation antipsychotics are less prescribed in Low and Middle Income Countries (LMICs) in a 2010 situation analysis included their high price and their limited availability in health centers (27-31). However, as risperidone is now off patent and its price is still decreasing gradually, it is feasible to rethink if risperidone should be added onto the next EMHSLU as an essential medicine in order to improve its availability.

Chapter 2. METHODS

A budget impact model was used to estimate the financial impact of introducing risperidone onto the essential drug list in Uganda, following the standard guidelines from the International Society for Pharmacoeconomics and Outcomes Research (32).

2.1 PERSPECTIVE AND POPULATION

The budget impact analysis was conducted from a payer perspective. In the case of Uganda which has, in theory, universal health coverage, it is the governmental perspective (33, 34). All patients with schizophrenia were assumed to have full access to treatment. The total number of schizophrenia patients was estimated from recent country population estimates, the annual growth rate, the global median schizophrenia prevalence, and the global median schizophrenia incidence (16-18, 35). The total patient numbers for schizophrenia treatment in the consecutive five years from 2016 to 2020 were 120,256, 123,864, 127,580, 131,407, and 135,350 respectively. All treated patients were assumed to be at the onset of the disease course, in a residual state, and receiving outpatient for first-line antipsychotics.

2.2 SCENARIOS TO BE COMPARED

With an assumed 10% annual increase in the market share of risperidone, an assumed 10% annual decrease of the market share of chlorpromazine, and an assumed constant market share of haloperidol, the total direct medical cost of schizophrenia treatment and the cost per tax payer per year in the following year was compared to the current year within the time frame of the analysis. The 10% annual uptake rate of risperidone was estimated from an observational study of the market dynamics after generic risperidone came onto the market (36). The study observed a monthly increase of the uptake rate from 3% in the first month that generic risperidone came to market to 25% increase after one year of risperidone's introduction. The 10% annual decrease of the market shares of chlorpromazine is assumed based on the findings that the market share of atypical antipsychotics increased at a similar speed as typical antipsychotics decreased (37, 38).

2.3 TIME HORIZON

The current treatments for schizophrenia are primarily chlorpromazine and haloperidol, which take up 80% and 20% respectively of the total prescription based on a cross-sectional survey carried out in the largest national mental health referral hospital in Uganda (19). With the addition of newly off-patent risperidone onto the essential drug list, risperidone is assumed to take up 40% of the prescription at the end of fifth year based on aforementioned market dynamics studies. In order to help make resource allocation decisions, the individual and aggregate costs of schizophrenia treatment per annum are estimated in this five-year period of budget plan, 2016-2020. Changes in the cost for budget holder each year compared to the previous year and changes of the cost per tax payer per year were also calculated to ascertain the changing impact of introducing risperidone onto the essential drug list.

2.4 COSTING

The costs included the drug cost, laboratory cost, and personnel cost. The costs were estimated through multiplying the unit cost of each drug, laboratory test, and personnel labor by the quantity needed for treatment. The primary data were reported by Lubinga et al. through medical chart review, health worker observation, other countries' publicly-available data, and literature review (39). For those who were admitted for acute EPS, artane injection was used to treat the acute symptoms. Discounting was not considered as the standard BIA practice suggests (32).

2.4.1 *Cost of drugs*

The costs of chlorpromazine, haloperidol, and risperidone are showed in Table 2.1. The chlorpromazine row of the table reads that chlorpromazine cost \$0.0388 per 100mg unit. The DDD

(Defined Daily Dose) of chlorpromazine is 400mg. Thus, the daily cost for taking chlorpromazine per patient is \$0.2101; yearly cost being \$77. The following two rows provide similarly information but are for haloperidol and risperidone respectively. Patients who experience acute episode are treated with artane injection. The cost of artane per injection was \$0.0121.

Table 2.1. Cost of chlorpromazine, haloperidol, and risperidone in Uganda collected from medical chart review by Lubinga et al.

Drug	Unit cost (\$)	DDD (mg)	Cost per day	Cost per year
chlorpromazine	0.0388	400	0.2101	77
haloperidol	0.0776	10	0.2101	77
risperidone	0.1552	4	0.1552	57

- DDD: Defined Daily Dosage

2.4.2

Cost for personnel

The personnel serving schizophrenia patients include psychiatrists, psychiatric clinical officers, psychiatric nurses, and pharmacy assistants. For schizophrenia inpatients, psychiatrists and psychiatric clinical officers go on one major ward round per week, taking around 20 minutes. Psychiatric nurses go on two major and two minor ward rounds per week, taking around 20 minutes for each round regardless of major or minor. All inpatients are seen by psychiatrists, psychiatric clinical officers, psychiatric nurses, and pharmacy assistants during their hospital stay. The average length of hospital stay is 60 days for schizophrenia inpatients. Only 25% of the schizophrenia outpatients are seen by psychiatrists. All outpatients are seen by psychiatric nurses and pharmacy assistants. Each outpatient visit in general lasts for 20 minutes. The average annual salary for psychiatrists is \$5,049. For psychiatric clinical officers, the annual salary is \$1,261. For psychiatric nurses, the annual salary is \$970. For pharmacy assistant, the annual salary is \$1,087. The average working time for all personnel were 2,000 hours per year. The cost for each patient's in-hospital

stay and outpatient visit was calculated from each type personnel's daily salary multiplying by the duration of their work for each stay or each visit. The personnel cost per inpatient per day was \$2. The personnel cost per outpatient per visit is \$1.3.

2.4.3 *Cost for lab tests*

Lab test for schizophrenia patients include Full Blood Count (FBC), Erythrocyte Sedimentation Rate (ESR), Treponema Pallidum Hemagglutination Assay (TPHA), Venereal Disease Research Laboratory (VDRL), and Human Immunodeficiency Virus (HIV) test. ESR is tested for inflammation or infection screening. TPHA and VDRL are for syphilis test. Each FBC test cost \$1.8630. Each ESR test cost \$0.2503. Each TPHA cost \$0.6678. Each VDRL cost \$0.3326. Each HIV test cost \$1.6019. The proportion of patients who need TPHA was 10%. All these tests need to be done quarterly. The lab cost per inpatient per episode was \$5.9428. The lab cost per outpatient per visit was \$5.0653. The lab costs for each inpatient's each episode and for each outpatient's each visit was estimated from the unit cost of tests multiplying by the frequency of the tests.

2.5 OTHER DATA

The probabilities of having EPS after being treated on each antipsychotic were extracted from the meta-analysis results of randomized clinical trials (23, 40). The formula for converting an Odds Ratio to a probability was used for comparator antipsychotic versus reference antipsychotic (41). By using the conversion formula, the probability of having EPS after taking chlorpromazine was 0.154. The probability of having EPS after taking haloperidol was 0.247. The probability of having EPS after risperidone was 0.126.

Chapter 3. RESULTS

The budget impact of adding risperidone onto the essential drug list for schizophrenia treatment was calculated as the cost of treating all schizophrenia adults with the gradual changing market share of risperidone, haloperidol, and chlorpromazine. The population of adults with schizophrenia was projected from the base year total population, population annual growth rate, schizophrenia prevalence, incidence, and mortality based on aforementioned epidemiological studies in either the context of Uganda or broader regional or international context. The market share of risperidone was assumed to increase from 0% in 2016 to 40% in 2020 with an annual increase of 10%. All schizophrenia patients were assumed to receive full-covered treatment from public healthcare centers. Funding for this full coverage treatment are assumed to come from all tax payers in Uganda.

The results of this budget impact analysis is presented in Table 3.1.

The analysis shows that the total cost for schizophrenia treatment for 2016, 2017, 2018, 2019, and 2020 are \$3,083,310, \$6,530,1034, \$5,716,574, \$5,995,643, \$5,962,597 respectively. This means for the first year of this budget plan, all tax payers need to pay about three million dollars to get all schizophrenia patients on treatment with 80% of them on chlorpromazine and 20% on haloperidol. With a 10% of all schizophrenia patients getting risperidone the next year, the total cost will increase to around 6.5 million dollars in 2017. After this almost 3.5 million dollars' increase in budget in the first year of the introduction of risperidone, the total cost decreases to 5.7 million dollars in 2018, and then fluctuates around 6.0 million dollars in 2019 and 2020. The market shares of the three antipsychotics from 2016 to 2020 are presented in Table 3.2.

Table 3.1. Budget impact of risperidone for reference case.

Result	2016	2017	2018	2019	2020
Projected schizophrenia population	120,256	123,864	127,580	131,407	135,350
Total number on CPZ	96,205	86,705	76,548	65,703	54,140
Total number on HAL	24,051	24,773	25,516	26,281	27,070
Total number on RIS	0	12,386	25,516	39,423	54,140
Outpatient cost	3,083,309.91	4,217,140.42	3,170,548.41	3,497,827.75	3,439,309.54
Inpatient cost	0	2,312,963.46	2,546,025.82	2,497,815.43	2,523,287.41
Total cost of CPZ + HAL + RIS	3,083,309.91	6,530,103.88	5,716,574.24	5,995,643.17	5,962,596.95
chlorpromazine	2,501,207.10	4,620,338.44	3,479,422.77	3,047,686.57	2,431,212.67
haloperidol	582,102.81	1,265,351.30	1,107,132.93	1,165,187.84	1,161,499.76
risperidone	0	644,414.15	1,130,018.54	1,782,768.77	2,369,884.52
Cost per tax payer per year	0.08205	0.16870	0.14339	0.14600	0.14097

- CPZ: chlorpromazine; HAL: haloperidol; RIS: risperidone

Table 3.2. Market share of chlorpromazine, haloperidol, and risperidone over the five-year budget plan.

	2016	2017	2018	2019	2020
chlorpromazine	80%	70%	60%	50%	40%
haloperidol	20%	20%	20%	20%	20%
risperidone	0%	10%	20%	30%	40%

SENSITIVITY ANALYSIS

The values for a number of parameters in this budget impact model could vary influencing the overall budget. In order to observe the changes of the overall budget as the parameters vary, a sensitivity analysis was done. Here we present the results for varying discontinuation rates of chlorpromazine, haloperidol, and risperidone, since the discontinuation rate of an antipsychotic affects the course of treatment and impacts the cost. The discontinuation rate of three antipsychotics were extracted from clinical trials. A probabilistic sensitivity analysis was used to randomly select a discontinuation rate for each antipsychotic from the beta distribution to which each of them belongs.

The parameters for these three beta distributions are presented in Table 3.3.

The lower bound, mean, and upper bound of total budget cost and cost per tax payer per year from 10,000 simulations is presented in Table 3.4.

Table 3.3. Parameters for three beta distributions that summarize the discontinuation rate of chlorpromazine, haloperidol, and risperidone from clinical trial evidence.

All-cause discontinuation rate	Base value	Low	High	SEM	Distribution	Alpha	Beta
Chlorpromazine	0.068	0.032	0.104	0.018	Beta	12.988	178.012
Haloperidol	0.084	0.044	0.123	0.020	Beta	15.964	175.036
Risperidone	0.057	0.024	0.090	0.017	Beta	10.906	180.094

Table 3.4. Lower bound, mean, and upper bound of total budget cost and cost per tax payer per year from a 10,000-simulation probabilistic sensitivity analysis.

	Total budget cost Mean (Lower bound, Upper bound)	Per tax payer per year Mean (Lower bound, Upper bound)
2016	3,086,392.364(2,822,949.484, 3,218,860.522)	0.00684(0.00626, 0.00714)
2017	6,360,845.71(5,887,328.68, 6,613,612.3)	0.01369(0.01267, 0.01424)
2018	5,717,033.99(5,379,327.07, 5,929,275.3)	0.01195(0.01124, 0.01239)
2019	5,996,016.07(5,700,964.35, 6,208,257.12)	0.01217(0.01157, 0.01260)
2020	5,962,858.28(5,676,350.50, 6,165,591.97)	0.01175(0.01118, 0.01215)

From this probabilistic sensitivity analysis, we project that the total budget cost fluctuates approximately a few hundreds of thousand dollars with different randomly-selected discontinuation rates. The fluctuation range is about one-tenth of the total budget cost, which is not a very large amount. Thus, the discontinuation rate appears to have a minimal effect on the total budget. The cost per tax payer per year fluctuates around \$0.001 with different draws of discontinuation rate from the beta distribution. The discontinuation rates of chlorpromazine, haloperidol, and risperidone altogether seem to have little influence on the cost per tax payer per year.

Chapter 4. DISCUSSION

The main findings of this analysis imply that to treat all schizophrenia patients in Uganda, an increase of \$3-3.5 million would be needed to allow risperidone to be included as an antipsychotic treatment. The amount of increase in the total budget for the treatment of schizophrenia will result in an increase of about \$0.15 burden on each tax payer. Overall, these costs appear to be affordable with the assumption that every schizophrenia patient in Uganda will be treated. Considering the reality of lower access and availability of antipsychotics, it is probable that a smaller proportion of schizophrenia patients would get treated resulting in lower overall costs (29, 42-44).

With the introduction of risperidone onto the essential medicine list, results presented here project that the total direct medical budget will double in the first year after the introduction, from 3 million to 6.5 million. As of 2014, the total health expenditure in Uganda accounted for 7.2% of the Gross Domestic Product (GDP) (45). The proportion of health expenditure in GDP didn't reach the 15%

that African Union countries agreed in the Abuja Declaration (46). The health expenditure per capita in Uganda was \$52 as of 2014 with a global average of \$1060 per capita in 2014. As GDP in Uganda for 2014 was \$27.76 billion, the health expenditure is estimated to be \$2 billion with a 7.2% share of the GDP. The total estimated budget for direct medical cost in the first year after the introduction of risperidone, 2017, 6.5 million, is going to be 0.325% of the total health expenditure, which is \$2 billion (47). Although 0.325% seems a reasonable percentage for the expenditure of antipsychotics among total health expenditure, this should be examined further. Currently the spending on mental health takes approximately 1% of the total health expenditure in Uganda from a national mental health system assessment project (29). Thus, the 0.325% of total health expenditure remains acceptable but maybe a bit high, since the 1% budget are allocated for the whole range of mental health problems including other serious conditions such as bipolar, depression, and alcohol abuse. In a 2007 study, the estimated expenditure per capita of scaling up a comprehensive mental health package was reported to be about \$2 for low income countries (48). The study involved a holistic mental health service package including pharmacological treatment, psychosocial therapy, and community intervention. From this perspective of a comprehensive mental health service package, the estimated burden of \$0.15 per tax payer per year for the addition of risperidone may be acceptable compared to the estimation of \$2 (49, 50).

Mental health budgets vary significantly by the economic status of the country. The median global expenditure on mental health was reported to be about 2.8% of the total health expenditure based on a 2011 estimation covering 8 Low Income countries, 18 Lower-Middle Income countries, 19 Upper-Middle Income countries, and 23 High Income countries (51, 52). For low income countries, the median mental health expenditure was about 0.5% of the total health expenditure.

For instance, in Bangladesh, the mental health budget comprises 0.44% of the total health budget (53, 54). The same proportion ranges from 9% to 20% across Europe depending on the specific country (55, 56) while it is about 10% in the US (57). The estimated 6.5 million and 0.325% of the total health budget, which we report in this study, is within the range of global statistics and in particular those from other LMICs. The median mental health expenditure globally is estimated to be about \$1.63 per capita per year, with low income countries having lower expenditure than their wealthier counterparts. An increase of \$0.14 payment from each tax payer per year in Uganda is still below the median per capita spending globally, and within the range of a per capita antipsychotic budget for other low income countries (43, 44) .

The first \$3.5 million increase of overall budget for direct medical costs in 2017 may be due to the large increase of inpatient cost in that year. There are two stages of the disease, acute exacerbation of positive symptoms and residual stage. Acute exacerbation of positive symptoms requires hospitalization, while residual stage can only keep maintenance medication (58). At onset of the disease, all schizophrenia patients are assumed to be in a residual state, so in the first cycle of the ten-state Markov model, or the first year of the budget impact model, all patients were assumed to be using outpatient services for care. This setting may vary in real life and further exploration is warranted to determine changes in costs due to modifications of assumptions involving inpatient care in 2016.

STRENGTHS AND LIMITATIONS

This analysis is based on a ten-state Markov model, on which the natural iterative course of schizophrenia is most likely to be best simulated by a mathematical model (59). Application of a

Markov model is appropriate for diseases in which each stage could happen more than once such as chronic diseases with relapse (60). Markov models have been used extensively for economic analysis on atypical antipsychotics for the treatment of schizophrenia. The analyses using Markov models for the specific situations in Mexico, Thailand, the US, and Brazil demonstrated helpful information for decision makers (50, 61-64). Another strength of this analysis is that by using some data from clinical practice in a real-world setting instead of clinical trials helps increase the accuracy of these analyses. Therefore, this analysis is likely to provide sound evidence for the treatment of schizophrenia in Uganda.

A limitation of this analysis is that the adverse effect profile of risperidone was not directly compared to those of chlorpromazine and haloperidol. The main adverse effects that are included in this analysis are EPS and diabetes. Risperidone has the lowest EPS probability and a moderate diabetes probability among these three antipsychotics. However, the total inpatient costs did not drop significantly with an annual increase of 10% in antipsychotic market share for risperidone. This might be due to slow uptake rate of risperidone, which reached the same percentage as chlorpromazine, 40%, at the end of 2020. This slow uptake rate may have an effect on the only slightly different total inpatient costs. In future studies, it would be important to utilize different market share sets to see the difference in inpatient costs under different market shares that may result.

The model used in this study assumed that all schizophrenia patients are age 18 or older at the onset of schizophrenia in the first cycle of the ten-state Markov model. The age distribution of schizophrenia patients used here probably doesn't comply with the assumption of the model.

Therefore, further assumptions on the age distribution among schizophrenia patients on the onset of schizophrenia should also be considered for understanding the impact on the budget; this may help the model to be more similar to a real-world setting.

Chapter 5. CONCLUSION

This analysis provides calculations to determine changes in the Ugandan budget that may take place should schizophrenia patients treated with chlorpromazine, haloperidol, and risperidone be modified according to specific discontinuation rates, diabetes probability, cost data, and epidemiological data. Results provide evidence for both the health and finance sectors in the Ugandan government to decide if changes in recommended antipsychotic medications should be implemented into policy. Although reality may differ somewhat from the parameters that were utilized in this analysis, this study still provides the best evidence currently available to facilitate the decision making process. While the implication that these results may have on decision makers and other stakeholders are important, there are certainly other considerations to be studied when it comes to adding a drug onto an essential medicine list, for example, the access and availability of essential drugs (21, 65, 66). Studies have shown that although some drugs are listed on the essential drug list, patients often are unable to obtain them in clinics due to low availability (67). Other studies have shown that some essential drugs have higher availability in private clinics but cost more, which limits the access to essential drugs for the general population (68).

In conclusion, the \$6 millions of budget impact for introducing risperidone onto the essential drug list for treating all schizophrenia patients in Uganda is potentially affordable. Further studies are

needed to provide a more real-world estimation of the budget impact of changes in essential drugs to include variability in the proportion of patients who get treated, the age distribution of patients at disease onset, and the proportion of inpatients at disease onset. This study is the first step in addressing modifications in policy that may ultimately help patients with schizophrenia in Uganda.

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