DEVELOPMENT OF A TARIFF TOOL FOR MEDICAL AIDS WITHIN AFRICA

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ABSTRACT

A medical risk management company provides medical claim assessment and payment for large medical insurers within Africa. The industry currently lacks cost and payment benchmarks, leading to abuse and significant continent-wide variation.

A database of paid claims, covering 18 African countries with 3128 medical providers, was mined and statistically analysed. This paper presents a model which was developed to provide a basic tariff and pricing structure for monitoring and capturing claims.

The model provides an appropriate-cost-threshold based on tolerable probability settings. This was partially achieved by inflation and exchange rate normalisation (including purchasing power parity). The model estimates and evaluates cost based on the country of treatment, medical condition and benefit option selected. It further provides decision support for appropriate currency of reimbursement. A preferential provider (Key accounts) list was developed using the model, to facilitate tariff and price negotiation.

The model was tested on third party data and significant initial savings were identified.
1 INTRODUCTION

Operating in Africa poses risks and challenges to medical insurance companies, due to the lack of legislation and governance, as well as logistic and operational difficulties. For this reason, these medical insurers outsource to companies that enable or manage aspects of medical administration. A South African company, MSO, performs Medical Risk Management in 21 African countries, with 5 offices on the continent. Medical insurance operations are complicated, as there is little or no price governance for medical care in Africa. This poses a substantial liability to all insurers, as well as their members.

South Africa has been less affected by this, due to the development of tariff schedules, such as the National Health Reference Price List (NHRPL). These, however, were often inaccurate, and were later scrapped due to their anti-competitive nature. Significant geographical, economical, infrastructural and cultural differences introduced error into any calculations. Continent wide introduction of a unified tariff and billing structure emerged as problematic.

The objective was thus to determine a reasonable fee and tariff benchmarking method for a number of the countries throughout Africa, and to validate this using historical data.

2 BACKGROUND

The majority of African private medical providers operate on a fee-for-service (FFS) payment system. This means that a provider sets the price of a service. Many African countries have governance in place to control the price of basic medication [1] [2] however, this has not expanded to other domains in medicine.

Medicines are a good [1] [2] and thus only variable costs such as logistics, risk and storage should influence price [2]. By contrast, similar pricing is difficult to implement in the service sector, due to the many variables that influence price, and the difficulty of determining accurate costing [3].

Creating a pricing model requires an understanding of the implicit constraints of the cost of healthcare and macroeconomic considerations affecting pricing across national borders.

2.1 Issues With Medical Costing

Healthcare costs are influenced by issues such as:

- Medical costs are typically hierarchical and escalatory: in that they increase depending on the degree of illness. This is difficult to quantify, and thus difficult to assign a cost to [4].
- Medical prices are often based on demand rather than cost. This means that the margin of profit is highly variable.
- Costs of services are difficult to quantify.
- Increases in prices are poorly correlated with inflation [5] [6].
2.2 Macroeconomics Of Problem

A number of factors are present in a historical based pricing structure.

2.2.1. Inflation

Inflation is the dominant force for price fluctuation in stable economies. In these markets, medical costs are not accurately modelled merely by inclusion of inflation, as provision must be made for decreasing costs due to economies of scale and improved efficiency [7].

The African economic condition is more erratic, having experienced significant inflation. Hyperinflation has a major effect on pricing, and even results in the abandonment of a particular currency.

In most states, Inflation is calculated based on the country’s Consumer Price Index (CPI) however the calculation differs. This is an issue in developing countries where low inflation is desirable to attract trade. Using an ad-hoc metric, the nation’s value of CPI is often different to that calculated by the World Bank.

CPI can be measured as a cost of goods index (COGI) or a cost of living index (COLI); an important distinction for medical care, where the service costs often exceed the goods cost.

2.2.2. Exchange Rates

The exchange rate is the comparative strength of one currency to another based on the international currency market. It is typically an indicator of a country’s economy, if not artificially restrained or bolstered [9]. It is directly related to the amount of trade that can be performed, and as a result, a balance is often sought. A low exchange rate makes importation difficult, whilst the opposite limits export trade [9].

2.2.3. US Dollar Dependency

Many African states have no manufacturing capacity for highly specialised, niched products that require high levels of technical complexity. These products must be imported, which is typically the case for medical supplies and equipment. These products are highly sensitive to exchange rate fluctuations.

Note: The current period of analysis coincides with global economic turmoil and a fair level of absence from standard economic behaviour may be found.

2.3 Decision Support Systems

Decision Support Systems (DSS) simplify decision making. DSS use deep data analysis to establish patterns and trends within historical data, or use established rules and structures to expedite process execution. This aids decision making and implementation. A competent DSS should enable an organisation to become leaner and more efficient by enabling better decisions and by eliminating time wastage for executing routine activities. [1]

DSS can be broadly split into two categories [1], i.e. data-oriented and model-oriented systems. Data oriented systems output simply processed data however the synthesis and decision steps rest with the human operator. By contrast a model oriented system models reality, performs more complex analysis behind the scenes, which may include statistical models, simulation and scenario testing. The input and environment here tends to be more complex and thus takes a lot of the synthetic load off the human operator for final decision.

3 METHOD

The investigation involved 18 African countries with a total of 3128 registered medical providers. A tool was developed to facilitate the monitoring and capturing of claims and to create tariff and pricing structures. The tool consists of 7 operations:

1. Initiate data collection
2. Populate tool claim database
3. Clean data sets
4. Generate statistics and Go/No-Go criteria
5. Manipulate sets to incorporate adjustments
6. Amalgamate the generated statistical sets
7. Facilitate in decision making

This process was used to analyse a substantial historical database of paid claims which gave a baseline for costs of procedures.

This model evaluates the cost per procedure and evaluates cost trends in different countries and by medical provider. Further richness is added to the model by evaluating the time at which cost variations were encountered, as this allows for an understanding of the then current economic framework of the procedure. This looks at economic conditions such as exchange and inflation rates.

4 RESULTS

Initial results showed an interesting distribution of value and volume as shown in Table 1 by the three possible filtering criteria:

- Frequency of condition
- Percentage of MSO approved US Dollar (USD) amount
- Average MSO USD approved amount

<table>
<thead>
<tr>
<th>Number of top conditions ordered by frequency</th>
<th>Percentage number of total conditions</th>
<th>Percentage of number of total claims contained</th>
<th>Percentage of total expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>50</td>
<td>1%</td>
<td>63.32%</td>
<td>43.97%</td>
</tr>
<tr>
<td>100</td>
<td>1%</td>
<td>73.82%</td>
<td>52.73%</td>
</tr>
<tr>
<td>300</td>
<td>4%</td>
<td>85.79%</td>
<td>67.99%</td>
</tr>
<tr>
<td>500</td>
<td>6%</td>
<td>89.59%</td>
<td>74.82%</td>
</tr>
<tr>
<td>1000</td>
<td>13%</td>
<td>93.65%</td>
<td>84.28%</td>
</tr>
<tr>
<td>7878</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

By frequency, the top 300 procedures (4%) accounted for 85.8% of claims. Figure 1 shows that the condition frequency is a good method for condition selection, having the greatest presence in the other two categories.
Figure 1: Top 300 Conditions By Criteria

Figure 2 shows the breakdown of number of claims by country. It can thus be seen that there are a number of countries that have far greater loads than others. This trend is primarily due to the distribution of members. Currently, one major multinational employer across the continent, with a large number of covered lives, had significant labour forces within the Republic of the Congo (Brazzaville) and Nigeria during the analysis period.

Figure 2: Claims By Country Of Treatment

The tool provides a value according to the country of treatment, medical condition and benefit option selected. The model calculates cost thresholds based on tolerable probability settings. Historical prices were adjusted according to inflation to determine equivalent current prices.

In order to incorporate inflation into the tool, two possible inflationary measures were developed, according to standard practice [10] [11].

- USD Approved Amount Inflation
- Local Currency Inflation

The local currency inflation rate was cross referenced against the year of treatment and used to modify the respective local currency price. The local price was converted to a USD amount using the applicable historical USD exchange rate.

Because prices are not necessarily adjusted in real-time according to foreign exchange rates, it is expected that if a currency fluctuates drastically, healthcare costs will be a lagging index. Countries that experience great exchange rate fluctuation build a buffer into their pricing, to prevent loss making cost structures.
4.1 Incorporation Of Statistical Analysis

Using pivot tables, it was possible to incorporate statistical analysis into the model. This was performed for the medical costs based on both a normal distribution, as well as a lognormal distribution. Initial research suggested that costs could accurately be modelled using the lognormal distribution [12], as it tended to favour a right-biased sample; a characteristic common to medical costs [4]. It was found that the lognormal distribution did not behave as expected, due to the significant variance that was experienced in most condition groups. This, however, was not an issue, as the normal distribution would naturally present a right-biased distribution, due to the absence of small claim amounts. Furthermore, through the assumption that care would have certain generic features, the need to perform regression analysis was avoided [13]. This also facilitated the use of a normal distribution, as condition cost distributions were assumed to be similar between providers within the same countries*.

4.2 Stability Of Currencies

Common currency commodities were analysed from the historical claims data compared to historical exchange rates [14]. This showed trends of currency stability. This informed long term pricing strategy and the claim approval process.

Stability was analysed by looking at proportion-based measurements due to the fact that certain currencies were many orders greater than others. As all payments are made in USD, all currency exchange rates were relative to this currency.

Figure 3 shows the stability of currencies under investigation over the past 12 months. A value near zero is desirable, as it indicates low levels of variation.

![Figure 3: Currency Stability: Sep 2010-Sep 2011](image)

Note the trend of increasing variance from left to right. This indicates that long term exchange rate fluctuation is a good indicator of general currency stability. There are, however, a number of currencies that do not follow this trend. Table 2 shows the full name and origin of currencies used in Figure 3.

These findings inform an exchange rate monitoring module for the pricing tool. A categorised list of currencies was generated based on currency stability. This list was used to notify if a more stable alternative local currency was available within the allowable currency list.

* This would typically be inaccurate; however, the availability of data necessitates this assumption.
It is apparent that currencies associated with the Middle East are the most stable†. This could be due to the substantial trade between fossil fuel based economies and the USA.

### Table 2: Currency Key

<table>
<thead>
<tr>
<th>Abbr</th>
<th>Country</th>
<th>Abbr</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDG</td>
<td>Sudan Pound</td>
<td>SAR</td>
<td>Saudi Arabia Riyal</td>
</tr>
<tr>
<td>KES</td>
<td>Kenya Shilling</td>
<td>AED</td>
<td>United Arab Emirates Dirham</td>
</tr>
<tr>
<td>CAD</td>
<td>Canada Dollar</td>
<td>MGA</td>
<td>Madagascar Ariary</td>
</tr>
<tr>
<td>JOD</td>
<td>Jordan Dinar</td>
<td>GBP</td>
<td>United Kingdom Pound</td>
</tr>
<tr>
<td>BHD</td>
<td>Bahrain Dinar</td>
<td>MKW</td>
<td>Malawi Kwacha</td>
</tr>
<tr>
<td>PKR</td>
<td>Pakistan Rupee</td>
<td>XAF</td>
<td>Communauté Financière Africaine (BEAC) CFA Franc BEAC</td>
</tr>
<tr>
<td>NGN</td>
<td>Nigeria Naira</td>
<td>EUR</td>
<td>Euro Member Countries</td>
</tr>
<tr>
<td>SYP</td>
<td>Syria Pound</td>
<td>XOF</td>
<td>Communauté Financière Africaine (BCEAO) Franc</td>
</tr>
<tr>
<td>NAD</td>
<td>Namibia Dollar</td>
<td>CDF</td>
<td>Congo/Kinshasa Franc</td>
</tr>
<tr>
<td>KWD</td>
<td>Kuwait Dinar</td>
<td>ZAR</td>
<td>South Africa Rand</td>
</tr>
<tr>
<td>EGP</td>
<td>Egypt Pound</td>
<td>TZS</td>
<td>Tanzania Shilling</td>
</tr>
<tr>
<td>UGX</td>
<td>Uganda Shilling</td>
<td>AUD</td>
<td>Australia Dollar</td>
</tr>
<tr>
<td>GHS</td>
<td>Ghana Cedi</td>
<td>CFA</td>
<td>Central African Franc</td>
</tr>
<tr>
<td>INR</td>
<td>India Rupee</td>
<td>MAD</td>
<td>Morocco Dirham</td>
</tr>
<tr>
<td>TRY</td>
<td>Turkey Lira</td>
<td>ZMK</td>
<td>Zambia Kwacha</td>
</tr>
</tbody>
</table>

### 4.2.1 Cost Variation Of Countries

Costs of procedures vary from country to country. This study tested whether a generic pricing hierarchy could be developed for the continent. Analysis was performed on all claim entries, as well as only the top 300 conditions ordered by frequency. It was seen that the analysis of all the claim entries was not applicable due to the absence of conditions within certain countries.

From the results obtained, a generic cost multiplier value was assigned to each country relative to Morocco. Morocco was selected due to its highly stable currency and inflation rate. Its proximity to Europe also means cost fluctuations associated with transportation are low. Malawi presented similar stability, which allows for transferral of the benchmark should Morocco destabilise.

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† This research was conducted prior to the events which would come to be known as the Arab Spring.
The relative cost multiplier of one country to another can be calculated as follows:

\[
\text{Cost of } A \text{ with respect to } B = \frac{A}{B}
\]

This result is used to provide pricing guidance when insufficient statistical significance is available for a condition in a particular country.
5 DESIGN ELEMENTS

5.1 Patient Transportation Intelligence

Cost ratios show that geographically proximate countries could have drastically different prices. This information could be used to justify patient transport to neighbouring countries (including estimated transport costs) to decrease procedure costs. Figure 5.

Figure 5: A Screenshot Of Transport Justification Window

5.2 Limitation Of Currency Use

Previously, any currency and related amount could be entered for a claim. It was seen that this was a major risk, as an incorrect currency selection could magnify the claim value drastically.

The limitation function analysed the currencies used for claims relating to a country within the historical data. A list was generated containing all countries and all respective currencies that were billed greater than 2% of the frequency for that country. Furthermore, all major stable currencies, such as US Dollar, Euro and Great British Pound were included.

The estimated travel costs were provided based on a non-critical event, however, more accurate values are required prior to utilisation.
This typically saw a total of between 6 and 8 allowable currency per country down from the previous 38.

5.3 Preferential Provider Listing

It was decided to include a preferential provider function. This would allow the tool to be used in a strategic role. Lists of providers according to country, condition and benefit were generated. This tool was also considered for inclusion within the operating window; however, it was believed that the knowledge that a provider is preferential may result in leniency, which may skew the respective pricing results.

5.4 Development Of Provider Details Search

Provider-specific detailed reporting enables both pre-authorisation and claims assessing processes. By knowing the provider’s nature of service as well as discipline, it allows for prevention of incorrect procedure approval for unqualified or inappropriate providers. It also allows for checking of claims versus the provider’s discipline, in order to prevent fraud.

6 TESTING

The model was tested to validate the pricing tariff process. All-Claims data from an independent insurer within Africa was used as the test data. It is important to note that this insurer is a different international medical aid, and thus has a different membership demographic. This was seen in the greater number of South African-based provider claims that were present. These were removed due to their dependence directly on the NHRPL, and hence their existing cost limitation.

1845 claims entries were selected for testing from the cleaned data. From this, 1374 claims entries were considered matching and hence applicable. Entries were systematically input into the tool by means of a cycling macro. The threshold probability was set at 80%. Pass or fail conditions were recorded.

Any difference of less than 10% of the average fee was considered to be paid after a letter of motivation, with anything greater being rejected.

The summated results are presented below

<table>
<thead>
<tr>
<th>Number of claims entries</th>
<th>Percentage paid initially</th>
<th>Total sum of claims</th>
<th>Total sum of initially rejected</th>
<th>Initial percentage saved</th>
<th>Paid as a result of less than 10 percent difference from average</th>
<th>Total savings</th>
<th>Percentage Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1374</td>
<td>78.5%</td>
<td>USD$168009.47</td>
<td>USD$7579.59</td>
<td>4.51%</td>
<td>USD$121.34</td>
<td>USD$7458.25</td>
<td>4.32%</td>
</tr>
</tbody>
</table>

This was only an indication as to whether the threshold value was a good limitation. This saving could be much greater depending on how strict the rejection criteria are. Member liability may also increase this saving dramatically. It is important to note that 4.3% is a substantial saving considering annual payments.

A test was performed using the NHRPL pricing register. Again, all South African-based provider claims were removed from the Test Claims Log. The related ICD10 codes that were captured were used to look up the related South African Rand cost. This was converted to USD using the average rate during the monitored period. This allowed for direct comparison.
As the NHRPL has stopped being generated, this has to be based on a previous list that has been adjusted for inflation. The results of the investigation can be seen in Table 4.

Table 4: Showing Results Of Comparison Of NHRPL Reference Values And The Pricing Tool

<table>
<thead>
<tr>
<th>Number of claims assessed</th>
<th>Number of claims exceeding NHRPL reference amount</th>
<th>Cost Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>643</td>
<td>432</td>
<td>1.88</td>
</tr>
</tbody>
</table>

This cost multiplier indicates that the pricing tool is 88% more lenient on condition spending that the NHRPL. This, however, is not unexpected considering that South African providers often charge up to 300% of the NHRPL associated value. These results are correlated against an average country cost, and have not been adjusted to consider the relative cost of each country.

7 FINDINGS

The creation of a medical condition pricing tool was investigated to facilitate the assessment and payment of claims for African providers. A number of findings were made:

- Value and volume trends were identified: 4% of conditions generate 85.7% of the total claims volume.
- Long term exchange rate stability predicted short term behaviour.
- Inflationary stability was strongly correlated with medical pricing continuity
- Accurate threshold pricing can be predicted for a condition within a particular country based on statistical analysis of previous claims.
- Use of the normal distribution gave adequate predictive ability
- Relative costs for African states were computed with Morocco used as baseline due to currency and other stability
- The tool provided a potential saving of 4.3% of approved claims amounts based on testing results.
- The tool was 88% more lenient than NHRPL-based prices.

8 CONCLUSION

The objective was to design a model-based decision support system to be rolled out in a medical insurance risk management company. The model was to determine a reasonable fee and tariff benchmarking structure for a number of countries in Africa. This was achieved and testing showed initial savings of more than 4%. It is believed that further development of this model can still raise this figure further.

9 REFERENCES


