# TAVI pilot outcomes: A South African healthcare funder perspective

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**BACKGROUND: TAVI (Transcatheter aortic valve implantation) is used to replace the aortic valve in the treatment of aortic stenosis in high-risk, elderly patients who are unable to undergo conventional surgical replacement of the aortic valve (SAVR). However, concerns remain regarding the costs, long-term outcomes and safety of the device. A registry was developed by a healthcare funder to assess utilisation, outcomes and cost of this procedure in their patient population.**
**METHODS: Registry data was collected for a period of 17 months. Clinical entry criteria included high-risk, elderly patients with symptomatic, severe aortic valve disease who were unsuitable for surgical valve replacement. Clinical outcomes were mortality, readmission and pacemaker requirements post-surgery. Primary outcome measure was all-cause mortality at 30 days.**
**RESULTS: A cohort of 78 patients was enrolled, mean age of 79.53 years. Procedures were performed in 7 centers around the country. Thirty day all-cause mortality was 9 (11.54%) with 5 deaths occurring on the day of the procedure. Eighteen (23.1%) patients were readmitted within 30 days. Average LOS was 5.71 (±4.06SD) days with an average cost of ZAR327 962 per patient.**
**CONCLUSION: Results suggest outcomes are similar to other settings and countries. Ongoing data collection is required to better understand long-term outcomes and costs.** SAHeart 2014;11:144-148

## INTRODUCTION

Aortic stenosis (AS), the most common valvular heart disease, is a degenerative disease resulting from a progressive age-dependent build-up of calcium that disrupts blood flow across the aortic valve.

TAVI (Transcatheter aortic valve implantation) refers to an aortic valve replacement whereby the aortic valve is inserted percutaneously via the femoral artery (transfemoral), the aorta (transaortic) or via the left ventricle (transapical). TAVI is used to treat patients with symptomatic aortic stenosis who are unsuitable candidates for surgical replacement of the aortic valve (SAVR).[1,2]

Prior to 2010, the clinical evidence for TAVI was limited to feasibility and safety studies as well as observational data from the SOURCE Registry.[3] Data from the US Partner Trials (Partner A and Partner B) was published in 2010 and these were the first randomised controlled trials investigating surgical and medical management of aortic stenosis as well as comparing these treatment strategies to TAVI. The inclusion criteria for Partner B, in a cohort of 358 patients, were patients who were ineligible for surgical valve replacement.[2] Results showed that, compared to standard management (usually balloon valvuloplasty), the mortality rate was reduced by 20% in patients undergoing TAVI. At 24 months the mortality rate improvement was 24.7% and patients undergoing TAVI had fewer re-hospitalisations (35%) compared to the standard treatment group (72.5%).[4] In the Partner A cohort longer term data (up to 30 months) showed that the clinical outcomes for TAVI, compared to SAVR in elderly high risk patients, are very similar but better than medical treatment.[5] A recent review by the Canadian Agency for Drugs and Technology in Health (CADTH) of clinical durability and effectiveness of TAVI greater than 12 months, supported the use of TAVI and confirmed the similarity in outcomes to SAVR but cautioned that the robustness of the longer-term clinical efficacy data is still limited.[6] Of concern is the increased risk of major stroke or silent cerebral lesions in TAVI patients compared to SAVR[6-8] although a recent RCT comparing TAVI to SAVR in high-risk patients showed no difference in stroke outcome between the groups.[9] Currently SAVR remains the gold standard in patients who are good candidates for surgery.

In response to the introduction of TAVI in the South African private healthcare sector, a pilot study of eligible patients requiring TAVI was approved for funding by a large private healthcare insurer, in South Africa in 2010. Funding was initially

based on a model of a global fee of R365 000 which incorporated the hospital cost, the doctor's fees, the TAVI valve and other in-hospital ancillary fees. Funding during the pilot (August 2010 - April 2012) was restricted to higher premium plan types and a co-payment was levied for the balance of the costs for the patient. Following the pilot, patients continued to be funded from the medical scheme benefit but the co-payment was removed from the higher plan types. A registry was implemented to collect data to inform further decision making around TAVI in this environment.

The aim of this study was to present the initial findings of the registry for TAVI patients and to assess whether outcomes and costs were comparable with other international registry experiences as well as in other South African settings.

In 2013 TAVI funding by the insurer was renegotiated, allowing the Global Fee to be reset at R337 000. However, even at the current global fee, the TAVI procedure is significantly more expensive than medical management which is the alternative for patients who are not eligible for SAVR. It is important to note that there is no effective medical treatment for aortic stenosis. Contingent to making funding available were the agreements with the hospital groups, the South African Society of Cardiovascular Interventionists (SASCI) and the manufacturers of the TAVI valves as well as a commitment by stakeholders to measure outcomes including, amongst other parameters, mortality and pacemaker utilisation rates.

The extremely high cost of the valve is of particular concern in South Africa and it has not proven to be cost-effective in this setting. Cost-effectiveness analyses done in the United Kingdom,[10] USA[11] and Canada[12] from the Partner trial included a lifetime analysis with cost projections beyond the 12 month trial period. The incremental cost-effectiveness ratio (ICER) outcomes of these studies suggested TAVI was cost-effective, however the cost-effectiveness thresholds used in the different studies are reflective of willingness to pay in those countries and cannot necessarily be translated into a South African context. In the UK study, the cost-effectiveness outcome was revised upwards from £16 100/QALY to £20 100/QALY[13] (Watt (b), 2012) which places it on the cost-effectiveness threshold limit. In the Canadian HTA study[12] the ICER was shown to be $48 912/QALY but with a range from $36 000/QALY to $291 000/QALY depending on the long-term extrapolation assumptions made in the model. The USA economic assessment[11] estimated an ICER of $61 889/QALY in the PARTNER B patients.

The Edwards Lifesciences Sapien® Valve was the first TAVI valve to be introduced into the South African Market in 2010 at a price of R216 000 (including VAT) per device. In 2011, the second TAVI valve, CoreValve®, from Medtronic was launched at a price of R188 177 (including VAT). This has since been revised to include other components and now costs R200 307.

## METHODS

Data for insured patients enrolled on the TAVI Registry were collected from August 2010 - December 2013. Initially patients were funded as part of a pilot project from August 2010 - April 2012. Following this, these patients continued to be tracked in the registry but were funded as part of the medical scheme benefits. Clinical entry criteria included only high-risk, elderly patients with symptomatic, severe degenerative aortic valve disease who were unsuitable for a surgical aortic valve replacement. Selection of patients for the procedure was determined by the patient's treating doctor(s) based on the SASCI treatment guidelines. For extraordinary cases an external panel of specialists was consulted. The choice of approach, either trans-apical or trans-femoral, was determined by the patient's treating doctor(s). Patients were required to sign a consent form for the collection of data.

Data entry fields for the registry were categorised into Patient Demographics, Procedure Details, Costs and Outcomes. As this is a retrospective database review of an administrative claims database, the clinical outcomes measured were mortality, readmission and whether the patient required a pacemaker post-surgery as a result of the TAVI procedure. The primary outcome measure was all-cause mortality at 30 days.

Costing data per patient was obtained from the claims database and included the global fee cost of the hospital admission (device, theatre time, hospital stay, doctor's fees) as well as any additional radiology, pathology, physiotherapy or other costs incurred during the hospital admission. Where a pacemaker implantation was required, the cost of the pacemaker was recorded separately to the global fee. Based on the individual clinical merits of the case, patients on lower premium plans were also approved up to the cost of the open surgical procedure. Costs were adjusted to 2013 in South African Rand (R) using the Consumer Price Index (CPI) as published on the Statistics South Africa website (Stats SA).[14]

Patient data was obtained from the claims database, collated and analysed in an excel spreadsheet. Statistical analysis was carried out using STATA®.

## RESULTS

### Patient Demographics

A cohort of 78 patients was approved for funding for TAVI up until the end of December 2013. The first 42 patients were enrolled on the pilot (August 2010 - April 2012). The remaining patients (n=36) were also enrolled in the registry but were funded through a different funding benefit. The mean (±SD) age of patients undergoing TAVI was 79.53 (±6.75) years. The ratio of males to females was 48:30 (61.5%; 38.5%) (see Table 1). All patients were considered to be high risk and unable to tolerate a surgical aortic valve replacement.

The procedures were performed at 7 centres around the country in 4 provinces (Gauteng, KwaZulu-Natal, Free State and Western Cape), see Figure 1. The majority of valves implanted were the Sapien® valve (76.9%) with only 23.1% of CoreValves® used to date. Since the introduction of the CoreValve® to the market in 2011, however, the proportion of Sapien® to CoreValves® used in the registry population has grown.

### Clinical outcomes

The 30 day all cause mortality was 11.54% (9 patients) with 5 deaths (7.2%) occurring on the same day as the procedure. Of the 42 patients in whom 1 year all cause mortality was measured, 14 patients (33.3%) died within 12 months of undergoing the procedure. There was an overall all-cause mortality rate of 21.79% (±0.41%) as measured in December 2013 in this patient population. The mortality rate for each year of the registry appears to be decreasing (Table 2.)

The average length of time from the TAVI procedure to death was 95 days.

**TABLE 1: Baseline demographics.**

| | Total (n=78) | Sapien® (n=60) | CoreValve® (n=18) |
|---|---|---|---|
| Age (Mean) | 79.53 years (±6.75) | 79.76 | 78.72 |
| Male n (%) | 48 (61.5) | 35 (58.3) | 13 (72.2) |

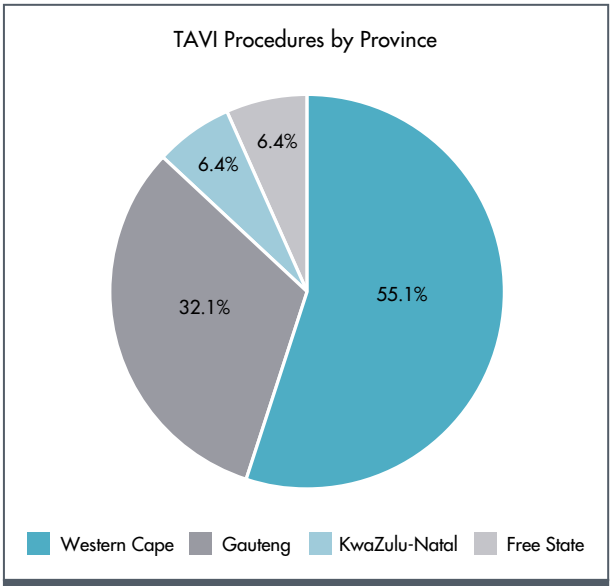


**FIGURE 1: Breakdown of procedures by Province.**

Hospital all-cause readmissions were counted as any admission post TAVI procedure. 23.1% of patients were readmitted within 30 days and of those readmissions, 5 were for complications related to the procedure itself (Table 3). Twelve months following the initial event, 34.6% of patients had been readmitted one or more times.

### Pacemaker requirements

Of the patients who received a TAVI, 7 (10.14%) required a pacemaker (either temporary or permanent). The frequency of pacemaker requirements decreased after the first year of the pilot from 4 used in the first year (August 2010 - July 2011), to 3 used in the second year (August 2011 - July 2012) and none required in the current period (August 2012 - May 2013). Only 2 of the pacemakers implanted were permanent.

### Procedure costs

The average length of stay for patients admitted for a TAVI was 5.71 (±4.06 SD) days with the maximum length of stay at 29 days, however this did not include patients who were admitted, discharged and then readmitted the following day. The average length of stay from date of the TAVI procedure was 5.25 days.

Over the duration of the registry, more than R24.5 million has been paid towards the TAVI procedures, with a median cost of R329 722 (±56 354) per patient. In addition, a median cost of R8 047 per patient was paid towards claims for other services that were not covered under the global fee such as pathology, radiology and ancillary services.

## DISCUSSION

The sample size of the patients enrolled in the pilot study was too small to carry out any meaningful statistical analysis. However, it does give a good indication of the expected outcomes in a South African private healthcare setting. These outcomes are not dissimilar to those reported in other international registries.

It is important to note that the majority of the pilot was carried out using the Sapien® valve and it was only in 2011 that the CoreValve® was introduced and reimbursed through the registry, hence the lower number of procedures and outcomes for that valve. The results of the registry analysis should therefore be considered with this in mind.

The 30 day all-cause mortality rate of 11.5% in this registry study was slightly higher than that reported in the Canadian registry study (10.4%),[15] in France[16] where rates of death at 30 days and 1 year were 9.7 and 24.0% respectively and in China[17] with a 30 day all-cause mortality rate of 10.4%. In a study carried out in the Western Cape, South Africa, in 70 patients using the Edwards Sapien® valve, the 30 day mortality rate was 7.1% with a procedural success rate of 97% (2 patients died during the procedure).[18] It appears that the 12 month mortality rate is declining with each successive year. This could

**TABLE 2: Mortality data for patients from August 2010 - September 2013.**

| Time period | n (total patients) | Deceased (by Dec 2013) | % | |
|---|---|---|---|---|
| 08/2010 - 07/2011 | 27 | 9 | 33.3% | |
| 08/2011 - 07/2012 | 19 | 6 | 31.6% | |
| 08/2012 - 07/2013* | 26 | 2 | 7.7% | |
| **Mortality** | **Total (n=78)** | **Sapien® (n=60)** | **CoreValve® (n=18)** | **p-value** |
| 30 day all cause n (%) | 9 (11.54) | 8 | 1 | 0.10* |
| 1-year all cause n (%) | 14/42 (33.3) | - | - | NS |
| Overall all cause n (%) | 17 (21.79) | 16 (26.7) | 1 (5.56) | NS |
| Same day n (%) | 5 | 4 | 1 | NS |

**TABLE 3: Hospital readmission data for patients from August 2010 - September 2013.**

| Readmissions | Total no of events (n=78) | Sapien® total events (n=60) | CoreValve® total events (n=18) |
|---|---|---|---|
| All cause readmissions within 30 days | 22 events (18 patients) | 17 events (14 patients) | 5 events (4 patients) |
| All cause readmissions within 12 months | 42 events (27 patients) | 26 events (16 patients) | 16 events (8 patients) |
| Pacemakers | 7 | 6 (10.9%) | 1 (7.1%) |

* *Fisher's Exact test used to compare mortality in Sapien® vs. CoreValve® cohorts.*

be due to reasons such as the result of better patient selection or increased familiarity with the procedure.

The overall pacemaker implantation rate in this study was 10.74% which is lower than other published rates. A recently published German Registry study analysing 1 391 patients undergoing TAVI, reported a pacemaker implantation rate of 33.8% and 34.5% (NS) in patients who died or survived respectively.[19]

The readmission rate of 36% was not unexpected in the patient population undergoing valve replacement surgery. What was of interest was the number of non-cardiac related surgeries taking place following the TAVI procedure. This was presumably due to patients now being well enough to undergo planned procedures, such as hip replacements, that they could not have considered previously.

The median cost of R329 722 per patient is lower than the current global fee of R337 000 as not every patient claimed for the full amount. The global fee is a result of negotiations with the manufacturers, healthcare professionals and the hospitals to reduce their costs and this is reviewed on an annual basis in light of updated data and outcomes. The global fee is reflective of the funding strategy implemented by the insurer and is not necessarily an indication of the true costs of the procedure in a fee-for-service environment. Published data for TAVI costs in South Africa from an abstract in Eurointerven-tion[20] reported mean TAVI costs of R374 500 (±46 800) based on fee-for-service charges. The average length of stay in hospital in that study was 7.7 days (2.8 days in ICU). A recently published analysis of the cost of TAVI in the same private hospital setting in South Africa showed similar results with mean TAVI costs of R335 500 (±47 900) although the length of stay was longer at 7.6 days.[21]

The cost of TAVI globally is often not clearly defined but reports in the literature vary from £16 500[22] to $70 000.[23] A recent review of re-imbursement for TAVI in Europe suggests that uptake of the procedure varies depending on whether the funding is based on a TAVI-specific national DRG (reimbursed in full) as opposed to a constrained funding system (only partially funded or funded by local trust or hospital budget).[24]

Open heart surgery is still the gold standard for the treatment of aortic stenosis in patients who are eligible for surgery. TAVI has shown benefits in patients requiring aortic valve replacement who are not candidates for surgical valve replacement, however long term outcomes are lacking. While the increased risk of harms (major stroke, cerebral lesions) associated with this procedure remains of concern, more recent trial data has shown that there is no difference in stroke outcomes in high-risk patients undergoing TAVI or SAVR.[9] The cost of the valve and additional costs including hospitalisation, radiology and pathology, cardiologist, anesthetists and other health professionals involved in the procedure make TAVI an expensive procedure and, currently, of uncertain cost effectiveness. Affordability is of particular concern in the South African private sector setting.

The success of the TAVI story in this large health insurer has been in the commitment by all stakeholders to engage in making this procedure more affordable. This is an ongoing process as each year the clinical evaluation and funding decision is revisited to ensure TAVI is accessible to the most appropriate patient groups.

## CONCLUSION

It is possible to measure outcomes of patients undergoing TAVI in a private healthcare setting based on database analysis. Results suggest outcomes are similar to other settings and countries. Ongoing data collection is required to better understand long-term outcomes and costs.

**Conflict of interest:** J Miot reports receiving consulting fees from Discovery Health in their Health Economics Unit. The other authors have no conflicts of interest to disclose.

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