Tympanostomy tube insertion practice in under-18-year-olds in the South African private healthcare sector insured by Discovery Health

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Background. The reported rates of tympanostomy tube insertion (TTI) in children vary significantly internationally. Lack of adherence to evidence-based clinical guidelines may contribute to these differences.
Objectives. To study the rates of TTI in South Africa (SA) in children ≤18 years old in the private healthcare sector, both nationally and regionally, to compare these with international TTI rates, and to determine the use of preoperative audiometry and tympanometry.
Methods. A retrospective analysis was done of data obtained from the Discovery Health database. Rates of TTI were analysed nationally and regionally and in different age groups, as was the use of tympanometry and audiograms.
Results. The SA TTI rates were much higher than published international rates except for the 0 - 1-year age group in Canada and Denmark and the 0 - 15-year age group in Denmark. There was a statistically significant regional variation in TTI rates as well as in the use of preoperative audiometry and tympanometry.
Conclusions. SA private sector TTI rates are high by international standards. Significant regional variations may indicate over- or underservicing in certain regions. Further investigation of causes for the high TTI rate and regional variations is recommended. Education of healthcare professionals on recognised indications for TTI may improve patient selection.

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Tympanostomy tube insertion (TTI) in children is employed principally for otitis media with effusion (OME) lasting ≥3 months with significant hearing loss (hearing loss of ≥25 dB in the better-hearing ear), to restore middle ear ventilation and shorten the duration of the effusion, but principally to improve hearing.[1] However, TTI is not without risk of complications and can cause otorrhoea, granulations, scarring, perforation, atrophy and retraction of the tympanic membrane.[2] Early extrusion or medial displacement of the tympanostomy tube can occur.[2] Complications of untreated acute otitis media and prolonged middle ear effusion include the potential risk of learning and language delay, recurrent courses of antibiotics with the risk of antibiotic resistance, and tympanic membrane changes.[3]

The American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS),[4] the American Academy of Pediatrics (AAoP)[5,6] and the National Institute of Clinical Excellence (NICE)[7] publish management guidelines for TTI. The AAoP recommends TTI for patients with persistent OME after a period of watchful waiting for 3 months, for patients with OME associated with speech, language or learning delay,[6] or for recurrent acute otitis media (rAOM), defined as three episodes in 6 months or four episodes in 1 year with one episode in the preceding 6 months.[5] The NICE guidelines recommend TTI for OME with a reduced hearing threshold of ≥25 dB in the better-hearing ear that has persisted for ≥3 months.[7] Both the AAoP and NICE guidelines require age-appropriate preoperative hearing assessment to be performed.

Reported rates of TTI differ widely between countries, with significant regional variations.[8,9] The TTI rate in South Africa (SA) has not been reported previously. The present study focuses only on TTI rates in privately insured SA patients as, in contrast to the public health sector, such patients have good access to TTI and are therefore more comparable to reports emanating from developed countries. Because Discovery Health (DH) has a 30% market share of the SA medical insurance market, its members are a good proxy for private TTI practice in SA.[10]

Methods

Study design and population

A retrospective review was done of all TTI cases in the national DH database for the 0 - 18-year age group over a period of 2 years (1 January 2012 - 31 December 2013). No patients were excluded. For the purpose of the study, a TTI was defined as a hospital admission for TTI. Admission for myringotomy and/or uni- or bilateral TTI was recorded as a single TTI. Insurance claims for preoperative tympanometry and audiometry were also recorded for the TTI patients.

Ethical approval for the study was obtained from the University of Cape Town Human Ethics Committee (ref. no. 015/2015).

Data analysis

Variations in TTI rates between regions were reported according to the *Dartmouth Atlas of Regions*.[11] Patients were clustered into age groups to compare TTI rates with reported international rates. The proportion of TTI patients for whom insurance claims had been lodged for preoperative tympanometry and audiometry was determined. A χ^2 test for trend was used to assess the association

between rates of preoperative tympanometry and audiometry. A *p*-value <0.05 was used as the cut-off for statistical significance.

Results

Among 74 126 patients aged ≤18 years who were insured by DH, there were 22 493 admissions for TTIs, with similar numbers and TTI rates in 2012 and 2013 (Table 1).

SA TTI rates compared with international rates according to age group are presented in Table 2. The SA TTI rates were much higher than published international rates, except for the 0 - 1-year age group in Canada and Denmark and the 0 - 15-year age group in Denmark.

Age distribution of TTI

Fig. 1 and Table 3 illustrate the age distribution of TTI in SA patients. The majority were children aged 0 - 6 years, with a peak age of 0 - 2 years.

Regional variations

There were wide regional variations of TTI rates in SA, with rates ranging between 69 and 246 per 10 000 (Fig. 2); the TTI rates varied by a factor of 3.6 between the lowest and the highest region. The regional TTI rate in <1-year-olds ranged between 22 and 176 per 10 000, i.e. by a factor of 8 (Fig. 3).

Table 1. Total number of TTIs per annum and rate of TTIs in patients aged 0 - 18 years

Year	Total TTIs, *n*	TTIs/10 000
2012	11 074	149
2013	11 419	148
Total	22 493	149

TTI = tympanostomy tube insertion.

Regional ratio of DH members to ENT surgeons

The regional ratio of the number of DH members to ear, nose and throat (ENT) surgeons varied widely (Fig. 4). However, the

Table 3. TTIs in SA according to age

Age group (years)	TTIs/10 000
0 - 2	380
3 - 4	318
5 - 6	171
7 -1 2	44
13 - 18	9

SA = South Africa; TTI = tympanostomy tube insertion.

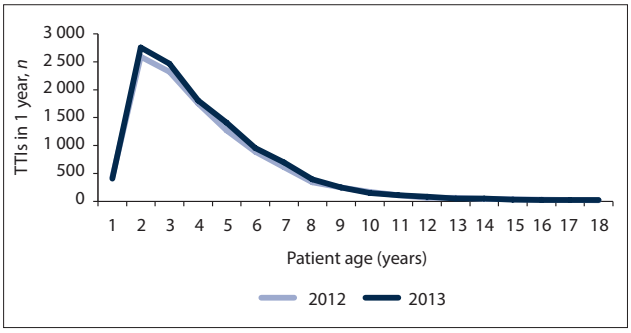

Fig. 1. TTI rates according to age in the study population. (TTI = tympanostomy tube insertion.)

Table 2. SA TTI rates compared with international rates according to age group

Age group (years)	Country	TTIs/10 000	SA TTI rate relative to other countries
0 - 18	SA	149	
0 - 16	SA	334	
	Finland[8]	51	6.55
	Norway[8]	43	7.77
0 - 15	SA	350	
	Denmark[27]	400	0.88
	Canada[28]	111	3.15
	USA[29]	89	3.93
	Australia[18]	56	6.25
	Scotland[30]	47	7.45
	UK[31]	21	16.67
0 - 14	SA	367	
	Canada[17]	84	4.37
0 - 12	SA	197	
	New Zealand[20]	69	2.86
	UK[20]	40	4.93
0 - 7	SA	578	
	Finland[32]	147	3.93
	Norway[32]	123	4.70
0 - 4	SA	356	
	Australia[18]	149	2.39
0 - 1	SA	89	
	Denmark[27]	1 990	0.04
	Canada[28]	128	0.70

SA = South Africa/n; TTI = tympanostomy tube insertion.

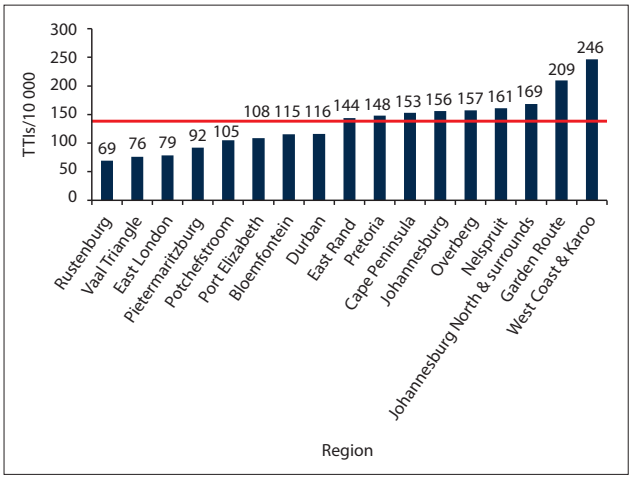

Fig. 2. TTI rates in patients aged 0 - 18 years according to region. The red line depicts the national average of 149 TTIs per 10 000 insured patients. (TTI = tympanostomy tube insertion.)

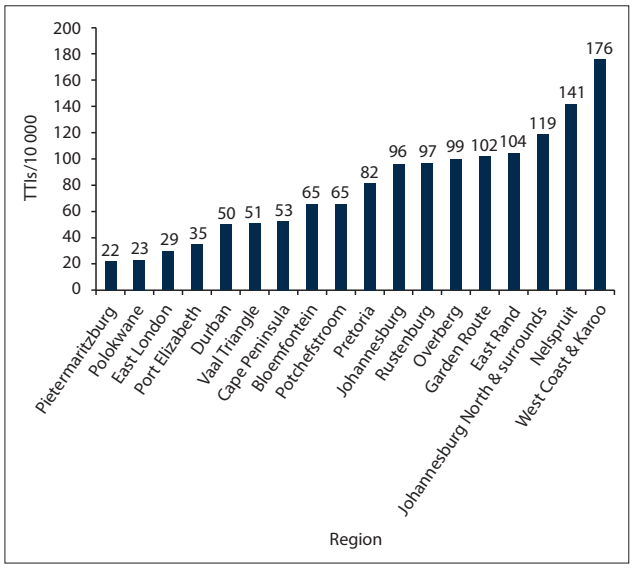

Fig. 3. TTI rates in children aged <1 year according to region. (TTI = tympanostomy tube insertion.)

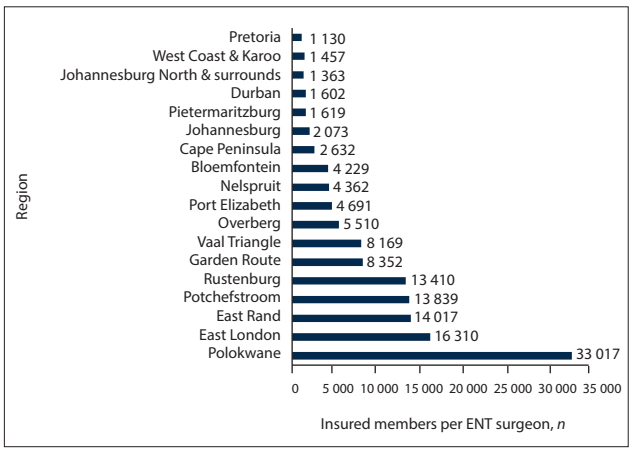

Fig. 4. Number of Discovery Health members per ENT surgeon according to region. (ENT = ear, nose and throat.)

correlation between the number of ENT surgeons per 10 000 and the TTI rate using Spearman's rank correlation coefficient was not found to be statistically significant (p=0.1633).

Preoperative audiology

There was significant regional variation in preoperative tympanometry (10 - 56%) and audiometry (30 - 74%) rates (Figs 5 and 6). These rates reflect only investigations funded by DH. Out-of-pocket investigations were not available for analysis and were therefore not considered.

Discussion

OME has a high prevalence in children, but resolves spontaneously in 80% of patients within 2 months.[12] Ninety percent of children will have had an episode of OME in the first 2 years of life.[12,13] There have been no studies on the prevalence of OME in the private healthcare sector in SA. It was found in a sample of 140 children utilising public healthcare facilities that the prevalence of OME was 16.5% for children aged between 2 and 16 years.[14] The prevalence of chronic suppurative otitis media in the same population was found to be 6.6%, which is classified by the World Health Organization as high. Because it is so commonly performed, TTI has a significant impact on healthcare costs; USD1.8 billion is spent annually in the USA on

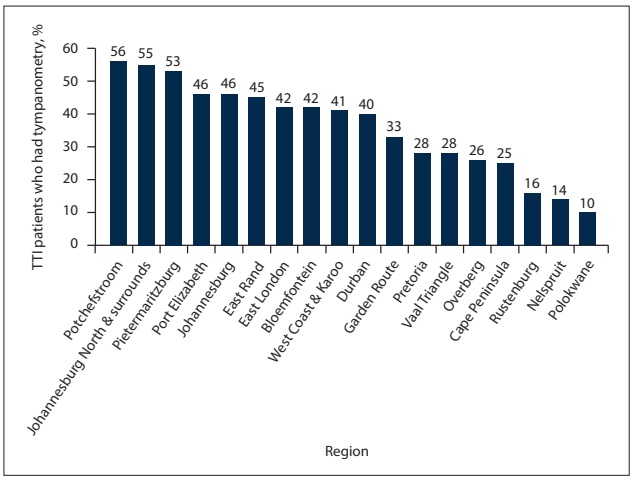

Fig. 5. Proportion of TTI patients who had tympanometry according to region. (TTI = tympanostomy tube insertion.)

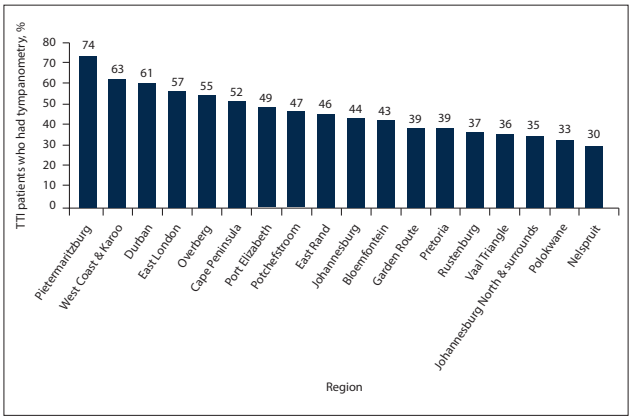

Fig. 6. Proportion of TTI patients who had audiometry according to region. (TTI = tympanostomy tube insertion.)

the procedure.[15] Best clinical practice aims to identify OME that will resolve spontaneously with watchful waiting without long-term sequelae, and patients who will benefit from the short-term hearing gain and reduction of otitis media episodes offered by TTI. The risks and expense of surgery and general anaesthesia must be weighed against the potential complications of untreated OME, antibiotic use and multiple visits to doctors. International working groups such as NICE, AAoP and AAO-HNS all have established guidelines aimed at reducing inappropriate TTI.[16] Despite access to these, rates of TTI vary between countries in the developed world.[17,18] Keyhani *et al.*[19] reported that clinicians in a New York-based study did not follow guidelines when recommending TTI, with only 30% of procedures in accordance with recommended guidelines.

TTI rates in DH patients are a good representation of the TTI rates in the SA private healthcare sector, given the substantial market share of DH. Paediatric TTI rates in the DH population are the highest in the world other than in Denmark, and in Canada in the <1-year-old group of patients. The SA TTI rate in the <15-year age group is 16.7 times higher than that in the UK.

Why should the TTI rate be so high in SA, and why should there be significant regional variations in TTI rates? The likely reason is that internationally recognised guidelines for TTI are not being adhered to or uniformly applied. Regional variations were also reported in New Zealand and in Norway.[20,21] The authors of the Norwegian study proposed that regional variation was due to individual interpretation of the Norwegian Medical Association guidelines, the guidelines not being prescriptive, and possible non-medical factors.[15,21] Regional variations reported in Canada and Australia were proposed to be due to the influence of family physicians.[17,18] In a New York study,[22] TTI was performed in cases that did not comply with accepted guidelines, and family disruption and theatre admission for another surgery were factors that influenced TTI. Areas with increased economic resources and/or private healthcare insurance have been found to have higher rates of TTI in Western Australia and in New York.[18,23] It has also been found in the USA that factors other than the prevalence of OME may affect TTI rates, namely race, health insurance and other unknown factors.[23] In our study, an association between regional ENT surgeons per capita and the TTI rate was not significant.

The finding that the majority of TTIs were performed in children aged <6 years is in keeping with evidence from the literature that there is a high prevalence of OME and rAOM in this age group.[15]

Our audit revealed low overall rates of hearing assessment and tympanometry assessment, with large regional variations, raising the possibility that clinicians in certain regions are not following accepted practice guidelines. Other than for rAOM, preoperative audiometry is required to determine that OME is accompanied by clinically significant conductive hearing loss prior to TTI. Audiological confirmation that hearing has improved to normal levels following surgery should also be standard practice. Lower audiometry rates in the 0 - 2-year age group could be explained by the indication for surgery being rAOM, but this postulate is unlikely to explain the drop-off in rates of audiometry in older age groups. Regional rate variation in the use of audiometry was also found in Western Australia.[18] Inequitable audiological access was cited as a possible reason for this finding.

The challenge of getting clinicians to apply evidence-based practice guidelines is well known.[24] However, it was shown that medical practice can be changed with passive dissemination of guidelines in the UK, where TTI rates decreased steadily from 1986 to 1992. Following the institution of guidelines, the rate of surgery decreased more rapidly from 1992 to 1997.[25]

Campaigns to disseminate information to clinicians and patients may not be enough to change clinical practice and improve adherence to guidelines, as has been shown in Sweden.[26] Peer review groups, open collaboration with pharmacists and accurate practice auditing and feedback have been shown to promote rational prescribing of antibiotics for rAOM in The Netherlands.[9] It has been suggested that these principles could be applied to healthcare systems that operate in a fee-for-service structure to change clinicians' behaviour.[26]

Study strengths and limitations

The strength of the study is that it was a national review with a large sample size, comprising all the TTIs performed on a well-defined population. The audiometry and tympanometry data quoted only include procedures that had been billed to DH; the study did not capture procedures that were paid for privately, and may therefore under-represent the use of these tests. Additionally, data were obtained from administrative sources (the DH database) without correlation with clinical details and knowledge of the indication for tympanostomy tube placement. As no validation of the data could be performed, there is a risk of misclassification, as with any other register-based study.

Conclusions

The high TTI rate, the possible low use of audiometry and tympanometry, and significant regional variations in TTI rates and use of audiology and tympanometry raise questions about whether internationally recognised best practice for OME and rAOM is being consistently adhered to in the private healthcare sector of SA. Increased rates could also be related to an increased burden of disease, and further study on this in the SA private sector population is recommended. Rigorous campaigns are needed to educate all levels of healthcare providers, medical insurance companies and parents about middle ear disease and its management based on internationally recognised practice guidelines.

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