# Identifying and acting on potentially inappropriate care? Inadequacy of current hospital coding for this task

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**Abstract**
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**Introduction:** Recent Australian attempts to facilitate disinvestment in healthcare, by identifying instances of 'inappropriate' care from large Government datasets, are subject to significant methodological flaws. Amongst other criticisms has been the fact that the Government datasets utilized for this purpose correlate poorly with datasets collected by relevant professional bodies. Government data derive from official hospital coding, collected retrospectively by clerical personnel, whilst professional body data derive from unit-specific databases, collected contemporaneously with care by clinical personnel.
**Aim:** Assessment of accuracy of official hospital coding data for hyperbaric services in a tertiary referral hospital.
**Methods:** All official hyperbaric-relevant coding data submitted to the relevant Australian Government agencies by the Royal Hobart Hospital, Tasmania, Australia for financial year 2010–2011 were reviewed and compared against actual hyperbaric unit activity as determined by reference to original source documents.
**Results:** Hospital coding data contained one or more errors in diagnoses and/or procedures in 70% of patients treated with hyperbaric oxygen that year. Multiple discrete error types were identified, including (but not limited to): missing patients; missing treatments; 'additional' treatments; 'additional' patients; incorrect procedure codes and incorrect diagnostic codes. Incidental observations of errors in surgical, anaesthetic and intensive care coding within this cohort suggest that the problems are not restricted to the specialty of hyperbaric medicine alone. Publications from other centres indicate that these problems are not unique to this institution or State.
**Conclusions:** Current Government datasets are irretrievably compromised and not fit for purpose. Attempting to inform the healthcare policy debate by reference to these datasets is inappropriate. Urgent clinical engagement with hospital coding departments is warranted.

**Key words**
Clinical coding; Data; Economics; Evidence; Health; Hyperbaric oxygen therapy; Policy

## Introduction

In August 2015, a paper was published in the *Medical Journal of Australia* (*MJA*) that attempted to develop a model to measure potentially inappropriate care in Australian hospitals.[1] Written from an economic perspective, this paper was based on a report prepared by the Grattan Institute, a self-proclaimed "*independent think tank focused on Australian public policy*".[2] Utilizing computerized hospital discharge data from all Australian hospitals for the 2010–2011 financial year (FY2010–11), the authors attempted to identify the hospital-specific incidence of selected diagnosis/procedure pairs that had previously been identified as 'inappropriate' in other literature.[1] The authors targeted five hospital procedures as having the potential for disinvestment on these grounds, and went so far as to recommend punitive measures against healthcare providers whose use of these procedures they deemed as "*outliers*".[2]

Amongst the 'do-not-do' procedures included in the Grattan study was "*(h)yperbaric oxygen therapy for a range of conditions including osteomyelitis, cancer, non-diabetic wounds and ulcers, skin graft survival, Crohn's disease, tinnitus, Bell's palsy, soft tissue radionecrosis, cerebrovascular disease, sudden deafness and acoustic trauma, and carbon monoxide poisoning*".[1] Hyperbaric oxygen treatment (HBOT) was by far the largest contributor to this study's results, comprising some 79% (4,659/5,888) of the procedures identified as potentially inappropriate. These results were problematic to the majority of Australian hyperbaric physicians since, in FY2010–11, both soft tissue radionecrosis and hypoxic non-diabetic wounds/ulcers were approved indications for HBOT under the Australian *Medicare Benefits Schedule* (*MBS*)[3,4] – and soft tissue radionecrosis remains so to the present day.[5] This *MBS* approval followed rigorous review of the available evidence by the Government's own Medical Services Advisory Committee.[6] Numerous other methodological flaws and factual errors have also been identified in the Grattan study, invalidating its conclusions and leading to calls for a formal retraction.[7,8]

A state-by-state breakdown of Australian HBOT use in the Grattan report clearly identified Tasmania as an outlier, with a rate of 'do-not-do' treatment approximately ten times higher than any other state.[2] This figure was not consistent with our understanding of local hyperbaric medicine practice and required explanation. The Royal Hobart Hospital (RHH) operates the only medical hyperbaric chamber in Tasmania and, as its co-directors, we had a responsibility to answer the charges levelled against this institution.[8]

During analysis of the Grattan paper, it became apparent that, amongst other problems, their primary data source may have been compromised. De-identified patient-level data about all public and private hospital separations (discharges, deaths and transfers) for the year in question had been obtained from the Australian Institute of Health and Welfare (AIHW) – the Government agency responsible for providing "*reliable, regular and relevant information and statistics on Australia's health and welfare*".[9] Diagnosis and procedural data submitted to the AIHW database were extracted retrospectively from individual patients' medical records by clinical coders at each hospital, utilizing the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification* (*ICD-10-AM*) for diagnosis coding and the *Australian Classification of Health Interventions* (*ACHI*) for procedure coding. Review of the HBOT data ("*Therapeutic Intervention 1888*") in the 2010–11 Procedure Data Cube on the AIHW website, however, demonstrated no apparent correlation with the Australian hyperbaric unit activity data published annually by the relevant independent professional society, the Hyperbaric Technicians and Nurses Association (HTNA).[10,11] Given that HTNA data derive directly from individual hyperbaric unit databases (collected contemporaneously with treatment by personnel responsible for providing the front-line healthcare services in question), it appeared reasonable to assume that it should be at least as accurate as the 'official' data collected retrospectively by the hospital coders. This current project arose from the necessity to explain the discrepancy between these two datasets.

## Aim

To review hyperbaric-relevant coding data submitted to the AIHW by RHH for FY2010–11, and compare this against actual hyperbaric unit activity as determined by reference to original source documents.

## Methods

All patients treated with HBOT at RHH between 01 July 2010 and 30 June 2011 were identified from the hyperbaric unit database. All coding data for every hospital presentation (hyperbaric-related or not) of these patients between those dates was requested from the hospital's clinical coding department. A separate list of patient medical record numbers for all individuals whom the hospital had coded as receiving HBOT (*ACHI* procedure codes 13025-00, 13020-00 and 96191-00 (Table 1A)) between these same dates was also requested to ensure that there were no patients coded as having received HBOT who were missing from the hyperbaric unit database. The official hospital diagnosis and procedure data codes were then compared against the hyperbaric unit database to identify any discrepancies in patient numbers, treatment numbers, treatment durations, dates and/or diagnoses. Any procedure code discrepancies between hospital- and unit-based data were resolved by reference to the original, hand-written dive log (which provides the definitive statement of who was in the chamber on the day in question and what treatment was administered). Diagnosis code discrepancies were resolved by reference to the patient's medical record and associated correspondence.

**Table 1**

Comparison of constraints on HBOT coding in the Australian Classification of Health Interventions (ACHI) and Medicare Benefits Schedule (MBS) systems; A. ACHI hyperbaric code numbers for fiscal year 2010–2011; B. MBS hyperbaric item numbers FY2010–2011

| | | | | |
|---|---|---|---|---|
| **A.** | ***ACHI* code number** | **HBOT duration** | | |
| | 13020-00 | > 90 min, ≤ 3 h | | |
| | 13025-00 | > 3 h | | |
| | 96191-00 | ≤ 90 min | | |
| **B.** | ***MBS* item number** | **HBOT duration** | **2010–2011 MBS-funded diagnoses** | **Doctor role** |
| | 13015 | 90 min to 3 h | Soft tissue radionecrosis | External |
| | | | Chronic/recurring hypoxic wounds | |
| | 13020 | 90 min to 3 h | Decompression illness | External |
| | | | Air or gas embolism | |
| | | | Diabetic wounds | |
| | | | Gas gangrene | |
| | | | Necrotising soft tissue infections | |
| | | | Prevention of osteoradionecrosis | |
| | | | Treatment of osteoradionecrosis | |
| | 13025 | > 3 h | Decompression illness | External |
| | | | Air or gas embolism | |
| | 13030 | N/A | Continuous life-saving emergency treatment | In-chamber |

**Table 2**

Treatments administered vs. treatments coded for the decompression illness/arterial gas embolism diagnostic category; bold numbers highlight where coding and treatment match correctly; RN – Royal Navy, USN – United States Navy; 18:60:30 and 14:90:20 in depth [msw]: duration (min): decompression (min) format; ToP – trial of pressure; all times measured from start of pressurisation to completion of decompression

| | ACHI hyperbaric code numbers | | | | |
|---|---|---|---|---|---|
| **Treatment table** | 13025-00 (>3 h) | 13020-00 (>90 min, ≤3 h) | 96191-00 (≤90 min) | Missed (not coded) | Number correct |
| RN62/USN T16 (270 min) | **5** | 4 | 1 | 2 | 5/12 |
| RN61/USN T15 (135 min) | 1 | **0** | 0 | 1 | 0/2 |
| 18:60:30 (95 min) | 1 | **7** | 1 | 3 | 7/12 |
| 14:90:20 (115 min) | 2 | **6** | 1 | 2 | 6/11 |
| Aborted/ToP/custom (≤90 min) | 0 | 0 | **0** | 1 | 0/1 |
| Non-existent (did not occur) | 0 | 0 | 0 | **N/A** | N/A |
| Number correct | 5/9 | 13/17 | 0/3 | 0/9 | 18/38 |

Once the cases had been matched between datasets and assigned to the appropriate diagnostic groups, a random study number was assigned to each case and all personal identifiers removed from the study dataset. Errors were then tabulated and compared within each of the following broad diagnostic categories: (a) decompression illness (DCI) and arterial air/gas embolism (AGE); (b) gas gangrene and necrotizing soft tissue infections, including necrotizing fasciitis or Fournier's gangrene; (c) diabetic wounds including diabetic gangrene and diabetic foot ulcers; (d) refractory non-diabetic hypoxic wounds (NDHW); (e) refractory soft tissue radiation injury (STRI); (f) osteoradionecrosis (ORN) prevention; (g) treatment of established ORN; (h) carbon monoxide (CO) poisoning; and (i) miscellaneous indications – looking for specific patterns of miscoding in each group. This study was approved by the relevant institutional Human Research Ethics Committee (UTas HREC Nº: H0015606).

## Results

One hundred patients underwent a total of 1,734 hyperbaric treatments at RHH in FY2010–11. One or more diagnosis and/or procedure coding errors were detected in the hospital data for 70% of patients (70/100). The proportion of patients whose coding was affected by errors varied by diagnostic category. One 'additional' patient who had not received HBOT that year was also identified as having been coded as receiving HBOT.

### PROCEDURE CODING ERRORS

Of all the patients who underwent HBOT, 6% (6/100) were not coded as having received any HBOT that year, and 8% (138/1,734) of the individual treatments administered were missing from the coding data. Seven 'false' HBOT episodes (which had not occurred) had been coded, including one hyperbaric treatment for the 'additional' patient described above.

The hyperbaric treatments actually provided by the unit were tabulated against the hyperbaric procedure codes available to clinical coders for each of the broad diagnostic categories described above. Table 2 shows the example for the DCI/AGE diagnostic grouping. These results were then combined to provide an overview of total hyperbaric unit activity and how it was coded (Table 3).

Of the 1,734 hyperbaric treatments actually provided to patients that year 1,344 were correctly coded (77%), with the remaining 23% being either miscoded as the wrong duration (15%; 252/1,734) or missed entirely (8%; 138/1,734). Accuracy of coding for a specific hyperbaric treatment table approximated the frequency with which that table was used, being most reliable (80%; 1,326/1,660) for the most commonly used treatment (14:90:20 table; 243kPa pressure (14 metres' sea water (msw) equivalent depth): 90 minutes duration at pressure: 20 minutes decompression).

Of the 1,603 hyperbaric treatments that were coded as occurring that year 1,344 were correctly coded (84%), with the remaining 16% being either miscoded as the wrong duration (15.6%; 252/1,603) or never actually having occurred (0.4%; 7/1,603).

### DIAGNOSIS CODING ERRORS

With many hundreds of diagnosis codes available in the *ICD-10-AM* coding manual, and no upper limit to the number that may be included in a single episode of care

**Table 3**

Treatments administered vs. treatments coded across all diagnostic categories; bold numbers highlight where coding and treatment match correctly; RN – Royal Navy, USN – United States Navy; 18:60:30 and 14:90:20 in depth [msw]: duration (min): decompression (min) format; ToP – trial of pressure; all times measured from start of pressurisation to completion of decompression

| | ACHI hyperbaric code numbers | | | | |
|---|---|---|---|---|---|
| **Treatment table** | 13025-00 (>3 h) | 13020-00 (>90 mm, ≤3 h) | 96191-00 (≤90 mm) | Missed (not coded) | Number correct (%) |
| RN62/USN TT6 (270mm) | **5** | 4 | 1 | 2 | 5/12 |
| RN61/USN TT5 (135 min) | 1 | **0** | 0 | 1 | 0/2 |
| 18:60:30 (95 mm) | 5 | **12** | 1 | 22 | 12/40 |
| 14:90:20 (115 min) | 24 | **1,326** | 204 | 106 | 1,326/1,660 (80%) |
| Aborted/ToP/custom (≤90 mm) | 0 | 12 | **1** | 7 | 1/20 |
| Non-existent (did not occur) | 0 | 5 | 2 | **N/A** | 0/7 (N/A) |
| Number correct (% correct) | 5/35 | 1,338/1,359 (98%) | 1/209 (0.5%) | 0/138 (0%) | 1,344/1,741 (77%) |

when active co-morbidities are included (up to 31 used in this patient series), there are an almost limitless number of combinations and permutations possible.[12] This was reflected in the diversity of codes used within each broad diagnostic category.

*Decompression illness/arterial gas embolism*

The primary diagnosis was appropriate in 14 of the 16 treated divers (T70.3 "*Other effects of decompression and barotrauma*"); however, only eight were coded as having sustained their injuries whilst diving. This reflects an idiosyncrasy in the coding manual: classifying recreational injuries by activity (U54.2 "*Scuba diving*"), but occupational injuries by industry (U73.00 "*Agriculture, forestry and fishing*") and location (Y92.82 "*Other specified place of occurrence, large area of water*"). Of the remaining two divers, one had a prior diving-related diagnosis from some years previously (dysbaric osteonecrosis of the hip, M87.95 "*Unspecified osteonecrosis, pelvic region*") transcribed forward for a presentation with DCI of the shoulder (condition and site both incorrect), and the other was missing from the coding. Of the two nosocomial AGE patients treated that year, both were appropriately coded.

*Gas gangrene and necrotizing soft tissue infections*

Two clinically almost indistinguishable necrotizing fasciitis patients were treated in FY2010–11. Each was coded differently; one as M72.65 "*Necrotising fasciitis, pelvic region and thigh*" + K61.3 "*Ischiorectal abscess*", and the other as N49.8 "*Inflammatory disorders of other specified male genital organs*" + K61.0 "*Anal abscess*".

*Diabetic wounds including diabetic gangrene and diabetic foot ulcers*

Over 46% (80/173) of coded HBOT episodes in this group had no mention of diabetes linked to that episode, being mainly (78/80) coded as L97 "*Ulcer of lower limb, not elsewhere classified*". Discussions with our coding department revealed that the guidelines for coding diabetes had evolved through several iterations over the past decade (Spurr B, personal communication, 2016) and that it had not always been standard practice to code for diabetes unless it was seen as an active problem in that particular presentation. However, this does not explain why these individuals could not be coded as being treated for established complications of diabetes like the remainder of this group (e.g., E11.69 "*Type 2 diabetes mellitus with other specified complication, ulcer (lower extremity)*" or E11.73 "*Type 2 diabetes mellitus with foot ulcer due to multiple causes*").

*Treatment of established ORN*

This was the most consistently coded Medicare-funded diagnostic category. All patients were correctly coded as having K10.2 "*Inflammatory conditions of jaws*" as their primary diagnosis; with Y84.2 "*Other medical procedures as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure; Radiological procedures and radiotherapy*" as secondary diagnosis for all but one treatment. Cancer was listed amongst the causes of the current episode in one of four patients (30/115 treatments). Since none of the patients were known to have active cancer at the time of HBOT this was inappropriate. The most appropriate cancer-related diagnosis, Z85.8 "*Personal history of malignant neoplasms*", was not used in any case.

*ORN prevention*

Various primary codes were used in this diagnostic category, reflecting the difficulty in knowing how to classify prophylactic treatments, as ORN does not actually exist at the time of HBOT. The likely most appropriate code, Z51.4 "*Preparatory care for subsequent treatment*" was used in only 10/130 treatments (one of seven patients). Inappropriate codes included: (a) C02.9 "*Malignant neoplasm of tongue, unspecified*" in 29/130 treatments (one patient), as the individual was cancer-free at that stage and, with no mention of radiation elsewhere in the coding, it appeared we were treating cancer with HBOT. (b) K10.2 "*Inflammatory conditions of jaws*" in 33/130 treatments (two patients), despite the absence of ORN at that time; (c) T66 "*Unspecified effects of radiation, radiation sickness*" in 29/130 treatments (two patients) was likewise inappropriate because it refers to radiation sickness – a specific acute syndrome not present in this type of patient; and (d) Z29.8 "*Other specified prophylactic measures*" in 29/130 treatments (one patient), which appeared initially to be potentially appropriate until it was realised that this code refers to fluoridation for dental health purposes.

There was no mention of malignancy (active or historical) amongst the diagnoses in 90/130 treatments (69%). Likewise, radiation was not mentioned in 57/130 treatments (44%). The most appropriate diagnoses (Z85.8 "*Personal history of malignant neoplasms*" + Z92.3 "*Personal history of irradiation*") were used in only the Z51.4 individual (10/130 treatments), but the simultaneous use of C00.9 "*Malignant neoplasm of lip, unspecified*" (despite the patient being cured some time previously) potentially confused the link between diagnoses and procedures.

*Carbon monoxide poisoning*

All patients (four) in this non-Medicare-funded diagnostic category were coded accurately as T58 "*Toxic effects of carbon monoxide, from all sources*".

*Miscellaneous indications*

The diversity of other 'off-label' indications for HBOT (nine patients, 112 treatments) precludes comment generally. However, a patient primarily coded as C20 "*Malignant neoplasm of rectum*", who incidentally developed central retinal artery occlusion (CRAO) secondary to atrial fibrillation during hospitalization, would appear in the coding data to have received HBOT for cancer since CRAO is not currently a Medicare-funded indication.

Assessment of the appropriateness of the *ICD-10-AM* diagnosis coding for refractory non-diabetic hypoxic wounds and refractory STRI (both approved for Medicare funding from 2004 under a new *MBS* item number, 13015)[3,4,6] was problematic because of the wide range of primary diagnoses that could lead to presentation. Confounding the issue further was confusion arising from the subtly different rules governing the *MBS* and *ACHI* procedure coding systems (Tables 1A and 1B). The greatest error rates in procedure coding were encountered in these two groups, reflecting this confusion. Eighty-one percent (499/614) of NDHW treatments were coded as 13020-00 and 11% (66/614) as 96191-00, whilst 67% (333/499) of STRI treatments were coded as 13020-00 and 25% (125/499) as 96191-00 (see below: GENERAL CODING ERRORS).

*Refractory non-diabetic hypoxic wounds*

No non-healing wound/ulcer was mentioned amongst diagnosis codes in 78/584 (13%) of coded treatments. It therefore appeared that HBOT was utilized to treat T88.8 "*Other specified complications of surgical and medical care, not elsewhere classified*", which excludes wounds (classified elsewhere) (15/78); M86.96 "*Unspecified osteomyelitis, lower leg*" (31/78), and T81.41 "*Wound infection following a procedure*" (32/78). This last case used the original hospital diagnosis (infected left total hip replacement) throughout multiple hyperbaric day-case admissions for a separate problem (a non-infected, demonstrably hypoxic, non-healing split-skin graft donor site).

*Refractory soft-tissue radiation injury*

No radiation-specific diagnoses were recorded in 72/475 (15%) of coded treatments. Wide variation was encountered in primary diagnosis coding, reflecting both the ability of cancer to occur anywhere throughout the body and the potential for radiotherapy to cause a range of injuries to both involved and neighbouring structures. Persistent use of the primary (cancer) diagnosis, even after the cancer was cured, with no mention of radiotherapy or its complications, led to 9/475 (2%) of HBOT in this group appearing to have been administered for cancer. Eleven percent of HBOT sessions (50/475, one patient) appeared to have been given to treat delayed complications of HBOT itself. This unusual circumstance appears to have arisen from an initial inappropriate code (Y84.8 "*Other medical procedures as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure, Hyperbaric oxygen therapy*", used instead of Y84.2 "*Other medical procedures as the cause of abnormal …, Radiological procedure and radiotherapy*") being perpetuated through multiple presentations, with no mention of radiation anywhere in the coding. Six percent (27/475) of treatments were inappropriately coded as being administered for T66 "*Unspecified effects of radiation, radiation sickness*". Radiation sickness is a potentially lethal acute syndrome of radiation poisoning not applicable to refractory STRI patients. Furthermore, the *ICD-10-AM* manual specifically excludes this patient's condition (L55-L59 "*Radiation-related disorders of the skin and subcutaneous tissue*") from inclusion under code T66.

## GENERAL CODING ERRORS

A number of other issues, unrelated to the difficulties encountered allocating appropriate diagnosis and procedure codes described so far, were also identified.

### *Default coding*

Thirteen per cent of coded treatments (209/1,603) were coded as < 90 min duration, only one of which (0.5%) was correct (Table 3). Discussions with our coding department revealed that, if clinical coders were unable to determine the duration of a given hyperbaric treatment, the shortest duration code (96191-00) was utilized as the default (Reynolds K, personal communication, 2016).

### *Cut-and-paste*

A large proportion of the diagnosis and procedure codes entered for each patient were identical, or nearly so, across multiple admissions for that individual. This was to be expected given that they were receiving multiple HBOT sessions for one specific condition. However the presence of identical typographical errors carried through free-text fields in multiple episodes of care for several patients (e.g., "*RENALF AILURE*" appearing 12 times across three patients) appeared to indicate that a 'cut-and-paste' technique was sometimes adopted. Whilst understandable, given the repetitive nature of coding these individuals, this would permit initial coding errors to be carried forward, multiplying their detrimental effect on data quality.

### *Random assignment*

Despite the potential cut-and-paste approach described above, not all patients were coded consistently throughout their course of treatment. The coding of identical hyperbaric treatments sometimes changed part-way through a course. Eight patients (249 treatments) had their HBOT variably coded as being > or ≤ 90 min (118/249 as 13020-00; 131/249 as 96191-00), whilst two patients (51 treatments) had their HBOT variably coded as > or ≤ 3 h (21/51 as 13025-00; 30/51 as 13020-00). All these episodes were routine, 115 min, 243 kPa HBOT exposures (14:90:20 table), documented in a consistent manner throughout the medical record. The apparently random assignment of treatment duration codes within an individual appeared due to a change in the coder responsible, and reflected their variable familiarity with hyperbaric treatment tables.

### *Missing patients*

Six patients were entirely missing from the official hospital HBOT coding. One CO poisoning was missing all three treatments as an inpatient, together with all intensive care (ICU) procedure codes, and was simply coded as receiving 95550-03 "*Allied health intervention, physiotherapy*". One STRI who aborted after 76 min on his first dive (oxygen toxicity seizure at 243 kPa), and did not return for further HBOT, was missed. One DCI (two day-case treatments) had no coding record of any episodes of hospital care that year. One AGE patient who aborted treatment after 10 min (unable to clear ears) was missed. Two NDHW patients were also missed: one missing all 19 treatments whilst an inpatient and one following a single treatment aborted after 10 min (claustrophobia from oxygen hood).

### *Missing treatments*

Thirty-three patients had incomplete coding of their HBOT course, the majority of which were related to inpatient admission. Twenty-six patients underwent 28 hospital admissions during which they received HBOT. Only 21/28 of those admissions coded any HBOT as happening and, of those 21 admissions, none coded more than a single HBOT episode. Inpatient treatments made up 8% (136/1,734) of HBOT treatments but only 15% (21/136) of those were coded. Of the missing day-case treatments, one dialysis-dependent patient who combined hospital visits for dialysis and HBOT had only one procedure coded (haemodialysis), when both were provided, on five occasions. Non-standard HBOT exposures (e.g., trial-of-pressure and aborted treatments) accounted for the majority of the remainder.

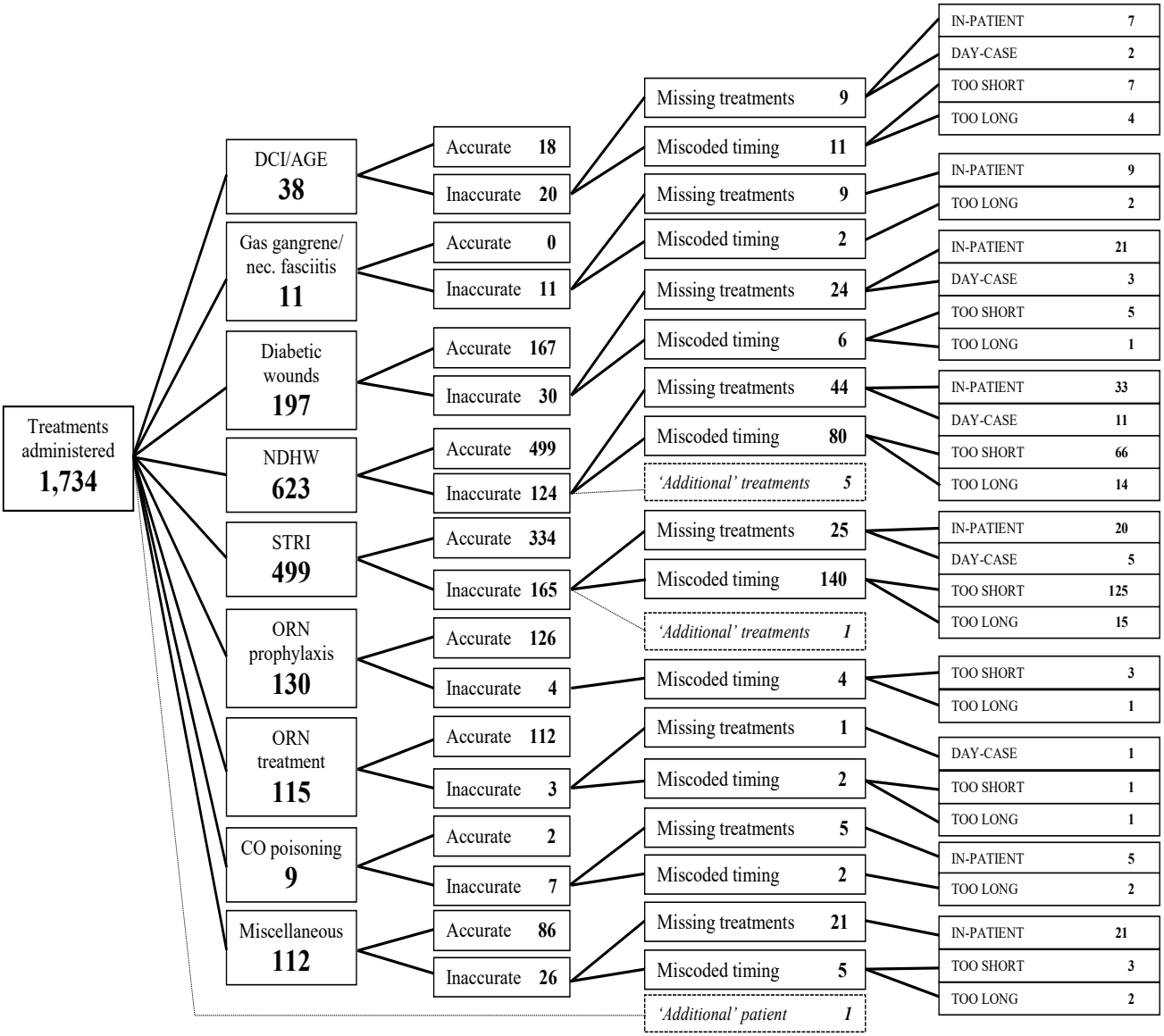
### *Extra treatments*

Six 'additional' treatments were identified amongst patients receiving HBOT. No reason was apparent in two cases, one of which coded an 'additional' treatment day and the other coded two treatments with different procedure codes (13020-00 and 96191-00) during the same day-admission. One patient presented for a scheduled treatment but HBOT did not proceed as they were unwell on the day. Another had a separate admission for non-HBOT reasons part way through their course, which was coded as including HBOT when it did not. One patient with a subsequent overnight admission (for a medically unrelated condition), after having received HBOT as a day-case earlier that day, had the same treatment coded twice. The sixth case arose from confusion between two patients with similar names, as the random appearance of one patient (five months after discharge) coincided with a 'missing' treatment for the other in the middle of their HBOT course. In light of their different hospital record numbers this remains difficult to explain.

### *Extra patient*

One 'additional' patient was coded as receiving HBOT. This individual received HBOT the next financial (but same calendar) year for head-and-neck STRI. On the date they were incorrectly coded as receiving HBOT, however, they actually underwent excision biopsy of a tonsillar lesion, and had yet to be referred for HBOT. Of note was the complete absence of coding for the surgical procedure (41849-00)

**Figure 1**
Procedure coding errors by diagnostic category




or associated anaesthetic (92514-29), despite the patient being recorded as admitted to the peri-operative unit under an otolaryngologist that day.

*Inpatient coding uncertainty*

The rules governing inpatient hyperbaric coding nationally were only clarified on 15 March 2016.[13] Prior to this it was unclear whether inpatient HBOT should be coded as a cumulative intervention (cf. 95550-00 "*Allied health intervention, physiotherapy*" – a single entry irrespective of the number of attendances) or as multiple discrete episodes during a single admission (cf. 44338-00 "*Amputation of toe*" – which was coded five times in a single admission for one diabetic patient). Although the system software would permit multiple sessions to be coded on the same day (as demonstrated by the presence of 'additional' treatments in two patients described above), no inpatient admission had more than a single HBOT session coded. A 'cumulative' approach to inpatient coding would, therefore, have been expected. Despite this, in all the 18 inpatient admissions where more than one HBOT session of > 90 min duration was administered, only seven admissions (24 treatments) coded HBOT as occurring for a total duration > 3 h (13025-00). Eight admissions (52 treatments) coded between 90 min and ≤ 3 h of HBOT (13020-00) and 3 admissions (29 treatments) coded ≤ 90 min of HBOT (96191-00).

*Non-HBOT coding problems*

Incidental observations of non-hyperbaric coding in this group of patients suggest that problems are not confined to hyperbaric medicine. Of five patients whose inpatient stay included mechanical ventilation in ICU, one was missing all procedure coding (ICU and HBOT) except 95550-00 "*Allied health intervention, physiotherapy*", despite a four

day ICU stay involving 49 h of mechanical ventilation and three HBOT sessions. Of the other four patients, one had the duration of ventilation miscoded (110 h coded as 13882-01 "*Management of continuous ventilatory support, > 24 and < 96 hours*"). The omission of all surgical and anaesthetic codes for the 'additional' patient described above also suggests that coding inconsistencies may be widespread.

## Discussion

In Australia, all medical procedures approved for government funding are assigned an 'item number' and listed (together with explanatory notes and constraints upon their use) in the Commonwealth's *Medicare Benefits Schedule Book*, updated annually.[3–5] Specific *MBS*-funded hyperbaric item numbers are constrained by patient diagnosis, HBOT duration, and the presence or absence of a doctor in-chamber (Table 1B). For hospital coding purposes, however, a different system is used – the *Australian Classification of Health Interventions* (*ACHI*). Although the *ACHI* classification is based upon the *MBS*, a two-digit suffix has been attached to each *MBS* item number to represent individual procedural concepts (e.g., 13020-00), and interventions which are not represented in the *MBS* are allocated a code number in the 90000 series.[12] Several other (sometimes subtle) differences are also present in the rules governing the application of these codes. Thus, whilst *MBS* hyperbaric items are constrained by duration/diagnosis/doctor-involvement, application of the comparable *ACHI* codes is dependent solely on duration and is irrespective of the condition being treated (Tables 1A and 1B).[13] For example, *MBS* Item 13020 specifically precludes the provision of HBOT under that item number for NDHW and STRI (covered separately by item number 13015) (Table 1B),[6,14] however, the *ACHI* provides no option but to code these treatments as 13020-00 if they are of the requisite duration (1 h 30 min to 3 h).[12] Failure to appreciate these differences may lead to difficulty interpreting the respective datasets, and cause all patients with these two conditions to appear as being treated or coded inappropriately.

Miscoding of procedure duration and omission of inpatient HBOT sessions were the most common problems across all diagnostic groups (Figure 1). The high coding error rates for the NDHW and STRI groups reflect the confusion described above. This issue could potentially be resolved by amending the two-digit suffix on the *ACHI* 13020-00 procedure code to reflect provision of 90 min to 3 h duration HBOT for non-*MBS*-13020-approved diagnoses (e.g., those covered under *MBS* item 13015). Individual procedural concepts of this nature are what the suffix is designed to account for but, despite *MBS* Item 13015 having been in use since 2004 and the *ACHI* claiming to represent "*the latest in contemporary thinking of clinicians, classification experts, epidemiologists and statisticians from both public and private sectors*", no such modification has yet been forthcoming.[12]

Issues such as these are unlikely to be unique to this institution. The same coding standards apply nationally, and Tasmanian coders are trained to a standard comparable to that of their interstate counterparts. A review of HBOT coding at a major interstate facility revealed a 25% error rate at that institution in that same year.[7] Whilst this paper illustrates that current hospital coding data are not fit for purpose, other reasons for the discrepancy in HBOT use between Tasmania and elsewhere must be sought.[8,15] Regional variation in HBOT provision has been discussed previously and several potential contributory factors have been identified.[15] Although beyond the scope of this paper, disease prevalence, chamber logistics, health service administrative systems, local geography and population distribution relative to the regional hyperbaric facility have all been implicated. It has been suggested that, rather than demonstrating inappropriate over-utilization in high treatment-rate locations, this variation is potentially indicative of unmet need in lower treatment-rate regions.[15]

## IMPLICATIONS FOR THE GRATTAN REPORT

The appearance that HBOT was provided for 'do-not-do' indications in the Grattan Report could arise from either (a) incorrect inclusions or omissions in the Grattan Institute's 'do-not-do' or 'potentially legitimate' diagnosis or procedure lists, or (b) incorrect inclusions or omissions in the diagnosis or procedure codes submitted to AIHW by the hospital.

The erroneous inclusion of NDHW and STRI amongst the Grattan authors' 'do-not-do' indications for HBOT would have resulted in 45 patients (1,059 coded treatments, six of which did not actually occur) treated at this institution in FY2010–11 being misclassified as 'inappropriate'. A major methodological flaw in the Grattan Report (inability to derive data on a per-patient basis) would, however, multiply this error and lead those authors to conclude that 1,059 separate patients received HBOT here inappropriately.[1,2]

Irrespective of this, and the numerous other methodological deficiencies identified in the Grattan Report,[8] coding errors have clearly compromised their primary data-source (AIHW) beyond repair. The omission of diabetes-related codes in three diabetic wound patients (80 treatments) added a further 80 'inappropriate' 'patients' to our tally using Grattan methodology, whilst one STRI patient (three treatments) with no mention of their intercurrent diabetes (an alternative, 'potentially appropriate' diagnosis) in their coding, added another three 'patients'. Finally, the inclusion of malignancy amongst the active diagnosis codes (even after clinical cure), in the absence of a radiation-related or other appropriate *MBS*-funded diagnosis code, led to three patients (39 treatments) appearing erroneously to be treated for cancer, adding yet another 39 'patients'.

## Conclusions

The AIHW dataset appears to be irretrievably compromised and not fit for purpose. The presence of coding errors in 70%

of our cohort invalidates any conclusions drawn from such data. Attempting to inform the healthcare policy debate by reference to such datasets is inappropriate and will inevitably lead to poorer outcomes for patients. A more rigorous approach to the validation of such databases is required if they are to serve any genuinely useful function.

Most clinicians would be unaware that *Australian Coding Standards* categorically state that "*(t)he responsibility for recording accurate diagnoses and procedures, in particular principal diagnosis, lies with the clinician, not the clinical coder*".[12] Therefore, we are held accountable for work performed by people over whom we have no authority or routine oversight. Engagement by clinicians with their hospital's coding department is, therefore, essential to develop strategies to facilitate extraction of accurate data from future patients' medical records.

It is ironic that clinicians who wish to introduce new therapies to the *MBS,* or even retain funding for existing interventions, are obliged to support their case with the highest-quality Level 1 clinical evidence, whilst non-clinicians pursuing a purely economic agenda can promote disinvestment in healthcare on the basis of contaminated data such as this. The medical profession has an obligation to challenge this blatant double standard.

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**Declaration of interests**

PDC and DRS are medical co-directors of the Department of Diving and Hyperbaric Medicine, Royal Hobart Hospital, Tasmania. DRS is also the current president of the South Pacific Underwater Medicine Society and has previously participated in the Commonwealth's MSAC reviews 1054 (2003) and 1054.1 (2011).


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