Review of public medical imaging funding model

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Abstract

Demand outpaces capacity in Radiology worldwide, in the context of limited public health funding and workforce shortages. This is contributed to by changing referral patterns, a drive to reduce hospital stays and new treatments. Resultant long medical imaging waitlists with delayed scans and procedures, as well as delayed turnaround times for reports compromise patient care.

The value of a radiology request is best triaged at the level of the referring doctor - who has insight into the full patient history, and prior examinations. It is hypothesised that providing referrers with information of the volume and cost of the scans and procedures they request will drive more judicious value-based requests. Placing the responsibility for providing at least some of the costs of the scans on individual clinical departments is anticipated to drive engagement to reduce low value requests as well as advocate for more funding if required.

Background

In order to utilise public health resources more efficiently, it is hypothesised that there are some low value activities in Medical Imaging that can be reduced or eliminated, whilst at the same time maintain or improve patient care. Unnecessary or low-yield scans lead to avoidable patient radiation and contrast risk, waste limited healthcare resources, push back much needed scans and increase report turnaround times of required scans. Yan et al estimates that low value imaging accounts for roughly a quarter of all imaging (Yan,2025).

Referring clinicians may not be aware of the effectiveness of their referrals or of the importance of a well-considered request. A limited 1 week audit on the numbers of duplicate requests incidentally discovered by administrators in a tertiary hospital (33 in number), represents a small subset of total duplicate requests - with others discovered post scanning. Many of these were already performed by external providers with forms written either by different referrers, or sometimes by the same referrer for different sites. In 2019, a 43 year old mother attended an unnecessary CT and died from anaphylaxis to IV contrast. Unnecessary or low-yield scans also lead to avoidable patient radiation, waste limited healthcare resources, push back much needed scans and increase report turnaround times of required scans.

Radiology is polyvalent (Hofmann, 2025) - valuable in diagnosing, monitoring, prognosticating and treating; whilst on the other hand can have negative values of false positives/negatives, overdiagnosis leading to over-investigation/treatment, and harms from radiation/contrast. Hofmann defines in another article (2025) that low value imaging is defined as that which is likely to result in more harm than benefit, and unlikely to change clinical management or reduce patient suffering compared to alternative actions.

We need to ensure the right scan at the right time.

It is technically possible to provide data to individual departments of request volumes and types, which can assist department heads in advocating for needed resources. Currently, new or increased services are challenging to accommodate by the radiology department due to long waitlists. Even if referring departments provide additional funds, it is difficult to recruit workforce ad hoc with piecemeal resourcing. Typically, required funding is advocated for by the medical imaging department when waitlists and report turnaround times blow out, with practical support achieved if workforce uplift is approved. Clinical departments are better placed to successfully advocate to hospital executives for increased funding to access the radiology services they need, as they are in direct patient-care positions.

Proposal

It is hypothesised that an overhaul of the current medical imaging funding model from historic expense based budget to fee-for-service for reports and procedures will lead to a more sustainable service and the reduction of low-yield requests.

Activities in a medical imaging department may be divided into two categories:

1) support functions – expenditure on these activities is not directly linked to patient care. They are also known as indirect costs or overheads. They include the maintenance of equipment, technology, 24/7 standby staffing, teaching, research and upskilling work (Figure 1). These activities have diffuse benefits, and they do not contribute to the marginal cost of production in the short run. It is noted by Pitman, et al. (2018) that patient-related non-study ascribable tasks and non-patient-related tasks (i.e. essential activities not directly related to scans or procedures) consume 50% of all radiologist working time. Given the characteristics of these activities they may be best supported via traditional budgeted funding, both rolling yearly budgets and budget bids. That said, with some effort, these activities may be incorporated into a cost reflective model via overhead allocation.

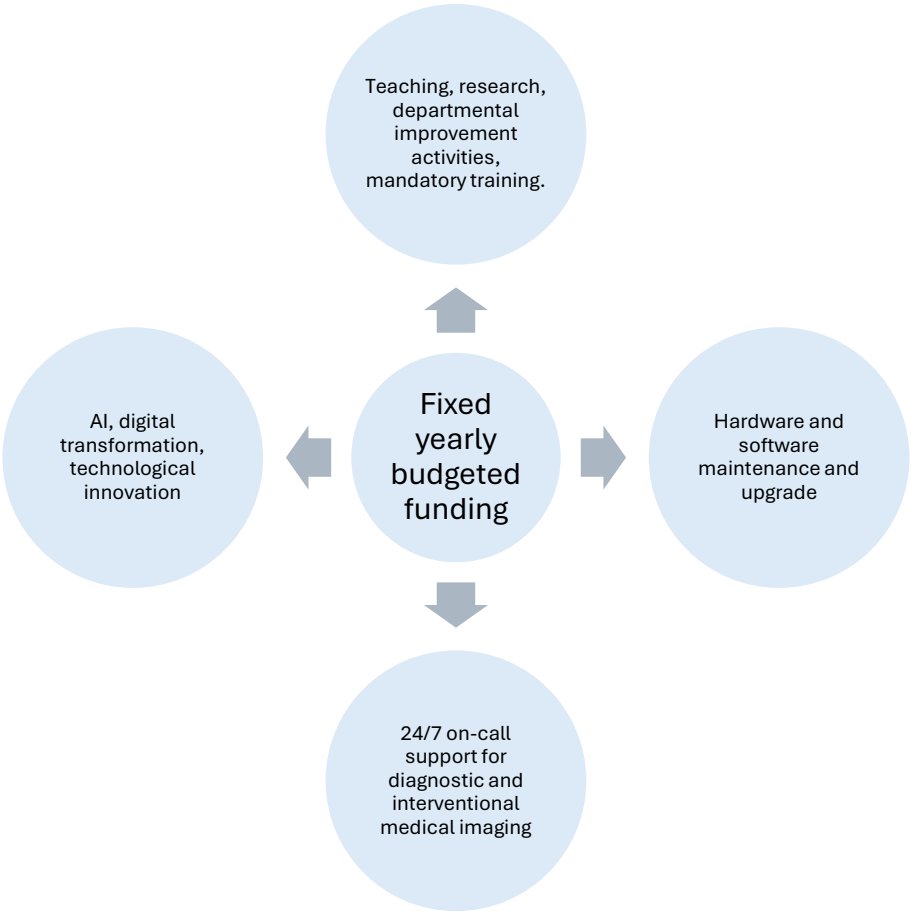


Figure 1: Activities suitable for fixed fiscal year budgeted model

Traditionally, reimbursement in radiology is based purely on the production functions of reports and procedures (Blackmore, 2007). However, quality in radiology includes other facets of radiologists' role in patient care - unmeasurable unfunded professional functions such assessing the appropriateness of the request, triaging, protocolling, research, teaching and peer support.

2) Patient care activities – those activities which could be more easily itemised and measured such as scans, procedures and multidisciplinary team meetings / case conferences (Figure 2). These can be linked to specific referring departments or referrers.

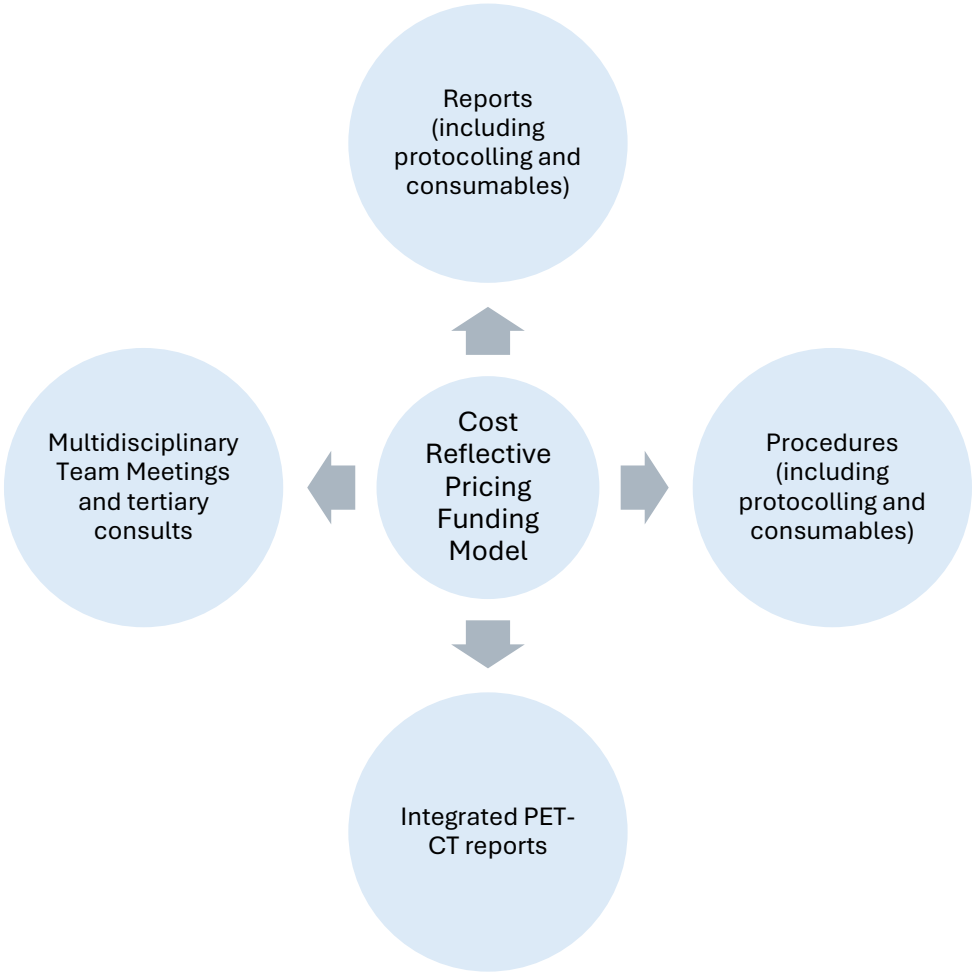


Figure 2: Activities suitable for fee-for-service model

A hybrid funding model combining current fiscal year yearly budgeted allocation, with monthly itemised per patient service costings to individual clinical departments is envisaged to optimally cater for both non-measurable maintenance or improvement activities, as well as measurable individual patient-related scans, procedures or multidisciplinary team discussions.

Cost reflective pricing model

The current QLD Health system allocates funding to the Hospital Health Service[1] (HHS) level via Activity Based Funding, and traditional budgeting at the individual unit level. Activity Based Funding determines the price at which services are purchased from HHSs, based on the number of Weighted Activity Units generated by the number and type of patients treated. This is only very loosely associated with referrals to Medical Imaging, because it does not directly attract funding.

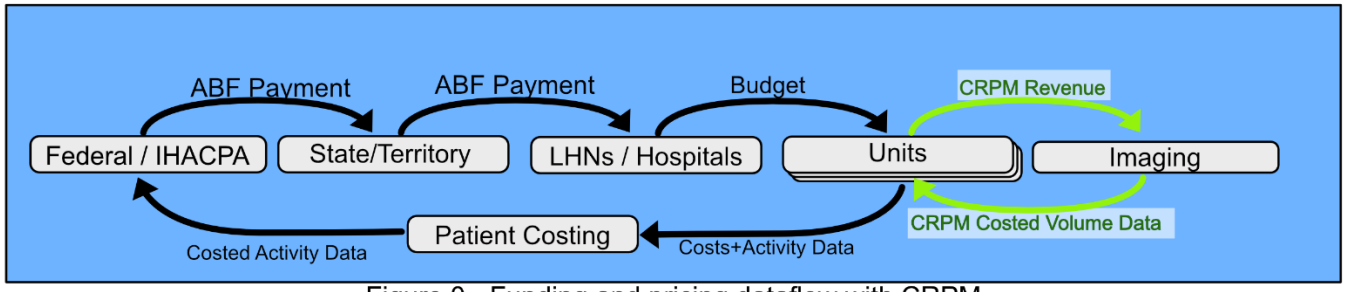


Figure 0 - Funding and pricing dataflow with CRPM

Activity Based Funding could be characterised as a practical solution to solve the age-old problem of the allocative inefficiency of governments – the "Economic Calculation Problem" as described by the Austrian school of economics (Hayek, 1935) and further debated in other economic schools as the "Socialist Calculation Debate". The crux of the problem is that central planners lack the complete set of information to efficiently allocate factors of production to produce (supply) the maximum amount of outcomes for patients (demand). In the ideal efficient market with prices, this information is present. Of course Activity Based Funding does not perfectly simulate a market or true prices, but it is a practical consideration in creating imputed prices to allocate funding to the states, territories and ultimately each patient's care. In practical terms, the federal and state treasuries do not know what type, volume and cost of services each HHS produces, they have little ability to distinguish what the relative resourcing requirements are. Nor is it easy to assess what combinations of interventions maximise patient welfare. Hence, ABF collects cost data from hospitals and in turn assigns a price to care. The process of generating the cost data provides a wealth of information – patient activity is characterised, catalogued and costed, and this is used to consequently set the National Efficient Price of care at a federal level. On the return journey from federal to hospital, it is used to allocate funding to each "level" of the administration - state, Health District, Hospital and Health service.

[1] in other states these are known as Local Health Networks or Local Health Districts.

The ABF's utility is not used to its full extent if it does not inform funding (or budget) allocation down to the individual unit level and provide information to the clinical decision-making. Instead, all that has happened is the allocation problem has shifted down the line to the Chief Financial Officer and central finance administration of the HHS – as they still lack the local knowledge required to allocate productive factors to maximise patient care. This also means that Individual referring departments and clinicians are not directly accountable for the costs of the diagnostic services they request, and are not provided with regular itemised information of their request volumes or types.

South Australia Medical Imaging's (SAMI) Cost Reflective Pricing Model is a monthly data churn allowing billing to individual hospital units. This has transformed the radiology department from a "black box", top-down block fund – opaque to imaging requesters, into a measured cost component of the patient episode. Bearing the cost of imaging provides the referring units an incentive to identify and reduce requests for low-value imaging. Value-based imaging is about bang for buck - the charge displayed in an itemized dashboard view provides the buck. Further improvements by providing test cost information in the Electronic Health Record (EHR) at the point of order could be considered, along with other quality use of imaging supports, including appropriateness criteria, clinical decision support tools, and evidence-based checklists (Yan, 2025). As for the bang – the value, automated EHR data analysis is being explored, to allow for determination of positive finding rates to compare with benchmarks. Identification of priority tests to undertake a cost effectiveness analysis (CEA) such as 6-step CEA for Diagnostic Imaging (Sailer, 2015) is another potential avenue, further supported by an accurate cost. The model breathes with activity increases, allowing increased FTE to maintain low turnaround times, which can reduce inpatient length of stay (which, for admitted public patients, improves the funding/cost ratio). This model would support value-based imaging in Qld public medical imaging.

Research

Evidence from prior trials and audits show that data-driven decision-making can drive positive change. A Commonwealth study in 2022 found that by providing GP letters comparing their diagnostic imaging ordering trends with their peers resulted in subsequent drops in the number of scans requested (Figure 3).

Australian Government
Department of Health

8 November 2019 Your reference: «reference_»

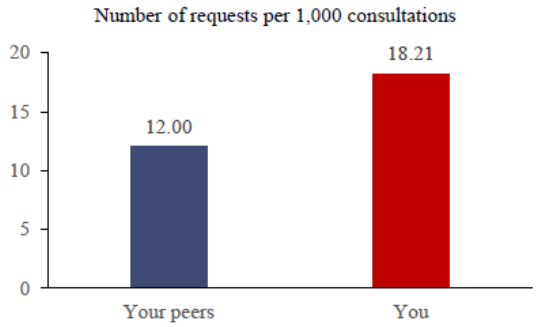
«Title» «First_name» «Last_name»
«Address_Line_1»
«Address_Line_2»
«Suburb» «State» «Postcode»

Dear «Title» «Last_name»

Your musculoskeletal diagnostic imaging request rate is higher than 80% of General Practitioners practicing in a similar geographical region in Australia

You may be aware that overuse of diagnostic imaging services has become a problem in Australia. Most people who present with musculoskeletal pain in the absence of worrying features do not need any imaging as it does not help management. Pain can improve rapidly, for example, around 50% of people who experience an episode of back pain will recover within 2 weeks.

I am writing to you because you request more musculoskeletal diagnostic imaging services than 80% of general practitioners (GPs) practicing in Australia, and your rate on 4 individual items is also higher than 80% of your peers. This rate is displayed below and in the table provided on page 3.



GPs are important stewards in maximising the quality use of diagnostic imaging for the benefit of patients. You can help by reflecting on your requesting data provided in this letter and limiting requests to only those clinical situations where imaging will change your patient's treatment plan and improve their health outcomes. The benefits of tackling this problem include reducing the potential for harm from cumulative exposure to ionising radiation for some investigations, as well as reducing the harm that can come from identifying incidental findings. Not only may this increase patient anxiety, it can also lead to a cascade of further unnecessary tests and treatments.

Figure 3: Feedback letter to GP to reduce overuse of diagnostic imaging

Audits of the percentage of positive findings associated with specific types of scans for specific clinical questions can help us understand the appropriateness of ordering patterns. For example, a prior study by a radiologist of bilateral lower limb ultrasounds for DVTs showed a very low positive rate – this resulted in the clinicians voluntarily honing their clinical indications and dropping the number of requests post audit.

Electronic health records (EHR) are making outcomes far less costly to measure. This matches the author John Hillier's experience, such as setting up a review of 165 CTPA reports for a hospital by bulk extracting from the EHR, and tabling the semi-structured report data for ease of review. Once designed, configuration and extraction took ten minutes versus the hours that it would take to obtain the datums, one-by-one.

Prior studies have shown that many physicians are unaware of the costs of tests or procedures they order. When clinicians were provided audits and feedback (through individual meetings, phone calls, and e-mails) on their use of low-value services compared with peers, along with educational materials, clinical guidelines and decision support software - reductions in imaging were observed (Colla, et al, 2017). Public reporting is typically used to disclose quality or cost information at the system, hospital, clinic, or physician level. Regardless of the form financial risk-sharing takes, it has been shown to reduce utilization and low-value care. Displaying cost data in the computerized order entry system reduced test ordering in one study.

It is important to also research potential unintended consequences of change, such as detracting the clinician from ordering necessary scans, not just reducing low-yield requests. Patient care must be maintained if not improved. Brook (2015) describes a study that found that free care increases health service use but does not improve health. In the experiment, people who had free care used about one-third more care than individuals who had some kind of copayment. More care did not equal better health, with similar health observed with those who cost share over five years observation.

Value-based holistic healthcare

Value-based healthcare (Cossio-Gil, et al., 2022) puts patient outcomes at the centre of the healthcare process by linking costs to outcomes instead of purely reimbursing for the services provided. A model of bundled payment for a care cycle incorporating outcome measurement has the potential to encourage a holistic patient-centred approach. Australia's public Activity Based Funding does provide some bundled funding, including for admitted acute and emergency patients, but outcome measurement is limited to funding reductions for targeted safety/quality reductions ("Funding types," National Health Funding Body, 2025). If volume is incentivised, volume is what is delivered - with the risk of devaluing quality.

Sarwar, et al. (2015) further describes that "Radiology is widely viewed as a contributor to health care costs without an adequate understanding of its contribution to downstream cost savings or

improvement in patient outcomes." For example, providing a minimally invasive Interventional Radiology procedure to coil a bleeding artery or treat cancer obviates the need for open surgery and may sometimes be the only treatment option, resulting in reduced overall hospital costs. Johnson & Anzai (2021) supports this by describing that high quality radiology can replace the use of higher risk, and higher cost health care resources. New metrics that measure how imaging reduces costs and improves outcomes over the entire episode of care will be useful.
Scott, et al. (2018) describe that value-based health care signals a clear move away from fee-for-service 'volume' based health care towards payment and rewards based on quality improvement and cost savings. Value-based purchasing measure and pay for health care services defined in terms of their relative quality, outcomes and cost.

The burden of system inefficiencies and the overuse of "low-value" imaging causes downstream impact on patients at the individual level, the economy and healthcare system at the societal level, and planetary health at an overarching level (Yan, et al., 2025). The concept of Value-Based Radiology has emerged as a shift in the perspective of radiology departments toward delivering high-value care centric to the patient, rather than the historical focus primarily on volume.

Conclusion

The opportunity costs and risk-benefit ratios of all referrals must be considered in the setting of limited resources and increasing demand. As health care organizations transition from volume-based to value-based goals of care, it is imperative that radiologists take charge and become creators of value-based metrics (Sarwar, et al., 2015).
"If you cannot measure it, you cannot improve it." - Peter Drucker

Brady, et al. (2021) indicate that referrers, who impose costs without incurring them directly (by utilising services which are paid for by patients or third party payers) must have greater accountability for their influence on the cost of medical imaging and for ensuring resources are utilised for optimum patient health benefit. Under-resourcing of potential bottlenecks in service delivery, such as radiology facilities, can impact negatively on outcomes for all patients.

It is hypothesised that a hybrid risk-sharing model of fixed annual funding and individual patient request costings for referrers will promote value-based medicine and support access to new or increased requests. This has the potential to have high organisational impact by driving value-based

accessible sustainable quality Medical Imaging scans, procedures and reports through best practice requests, optimised multidisciplinary team meetings and effective radiology department processes.

This model requires buy-in from health care executives and referrers to succeed. Pilot trials could be conducted at RBWH to assess patient outcomes, should stakeholders consider investigating this innovative data and funding model - which as the potential to significantly alleviate public hospital pressures and add value without additional funding.

References

Blackmore, C. C. M. D. M. P. H. (2007). Defining Quality in Radiology. *Journal of the American College of Radiology*, *4*(4), 217-223.

Brady, A. P., et al. (2021). Radiology in the era of value-based healthcare: A multi-society expert statement from the ACR, CAR, ESR, IS3R, RANZCR and RSNA. *Journal of medical imaging and radiation oncology*, *65*(1), 60-66.

Brook, R. H., 2015, Redefining health care systems. *RAND Corporation*, Santa Monica, Calif.

Colla, C. H., et al. (2017). Interventions Aimed at Reducing Use of Low-Value Health Services: A Systematic Review. *Medical Care Research and Review*, *74*(5), 507-550.

Cossio-Gil, Y., et al. (2022). The Roadmap for Implementing Value-Based Healthcare in European University Hospitals—Consensus Report and Recommendations. *Value in health*, *25*(7), 1148-1156.

Department of Health and Aged Care, 2022; Reducing Overuse of Diagnostic Imaging. *Commonwealth of Australia*.

Hanneman, K. (2025). Environmentally Sustainable Radiology: Redefining Value and Quality. *Canadian Association of Radiologists journal*, *76*(1), 19-20.

Hayek, F.A. ; Pierson, N. G.; Von Mises, L.; HALM, G. & Barone, E. (1935). *Collectivist Economic Planning*.pp201-290

Hofmann, B. (2025). Low-value imaging: concept analysis and definition. *European journal of radiology*, *183*, 111858.

Hofmann, B. (2025). Mapping the values of radiology. *European journal of radiology*, *183*, 111901.

Johnson, P. T., & Anzai, Y. (2021). Radiology at the Helm of Value-Based Care Transformation: From Stewardship to Leadership. *Journal of the American College of Radiology*, *18*(9), 1226-1228.

Medical care research and review, 2018, 75 (1), pp. 3 – 32.

National Health Funding Body. (2025). *Funding types*. Public hospital funding. https://www.publichospitalfunding.gov.au/public-hospital-funding/funding-types

Pitman, A., et al. (2018). Measuring radiologist workload: Progressing from RVUs to study ascribable times. *Journal of medical imaging and radiation oncology*, *62*(5), 605-618.

Sailer, A. M., et al. (2015). Cost-effectiveness modelling in diagnostic imaging: a stepwise approach. *European radiology*, *25*(12), 3629–3637.

Sarwar, A., et al. (2015). Metrics for Radiologists in the Era of Value-based Health Care Delivery. *Radiographics, 35(3), 866-876*.

Scott, A; Liu, M; Yong, J, Financial Incentives to Encourage Value-Based Health Care,

Yan, T. D., Jalal, S., & Harris, A. (2025). Value-Based Radiology in Canada: Reducing Low-Value Care and Improving System Efficiency. *Canadian Association of Radiologists journal*, *76*(1), 61-67.

Appendix: Excerpts from "SA Medical Imaging (SAMI) Cost Reflective Pricing Model - Lessons learned and recommendations for Time Driven Activity Based Costing (TDABC) in radiology." By John Hillier

Benefits realised

- Improved accuracy of patient costing feeds back into accurate funding via the ABF system.
- Improved transparency and comprehension of medical imaging costs versus the black-box nature of block funding arrangements.
- Fixed nature of block funding tends to lead to underservicing as funding is fixed but services can be cut or scaled back; costed activity under a Time Driven Activity Based Costing model allows expansion of services to be brought on.
- Allows medical imaging to focus on providing a quick, responsive service (Turnaround Time KPIs)
- Literature review revealed MBS fee relativities have not been examined in detail for medical imaging[2] – base MBS fees for modalities, radionuclides et al were derived as far back as the 1970s and may no longer be fit-for-purpose – significantly changed business practices and costs. As such these "bulk bill" values are not representative of the cost of service.
- Provides a dollar value impact for business cases - where additional FTE will allow for additional activity, the model makes it trivial to calculate an associated revenue estimate to the unit.
- Better visibility and consideration of time and dollar impact of Multi-Disciplinary Team (MDT) meetings for both the requesting/chairing unit and medical imaging.
- When additional MDT meetings are requested, the FTE impact is assessed. If additional resourcing is required to attend – the model ensures that resourcing is already funded.
- Built-in consideration for the significant resourcing impact of teaching and training, particularly side-by-side training of registrars.
    - Teaching and training costs are spread over the entire activity base to ensure statewide teaching and training is funded regardless of whether an image is ordered from a teaching or non-teaching site.
- Dashboard output provides a rich Medical Imaging data source to departments and units.
- Full funding of radiology department with respect to operational costs.
- Full cost of medical imaging functions passed to referring units
    - When programs pay for what they request, questions start to be asked such as – "Do we need to order this?".
- Builds cross-functional knowledge within the organisation.
- Spawned numerous discussions within medical imaging and with Local Health Networks. Better connected central office team to sites and spawned data requests for other purposes within Medical Imaging.
- Valuable side-effect – the process acts as an audit of data, costs and practices – discovered data problems, and risks in systems, accounts, intra-hospital charging, procurement and inventory processes.
- Identification where MBS scheduled fee is insufficient or overly generous versus procedure costs.

The tension of government

Good governance requires the constructive management of tension. In any resource-constrained environment, there is a tension between what is needed (or wanted), and what can be afforded. This is all the harder to manage in healthcare because the stakes are much higher when constraining resources can have quite visible costs – of human suffering. A patient, and their family and friends, usually expect the best treatment available. Similarly, a clinician wants peace of mind that they made the best decisions and interventions possible – made by using the resources that could have been provided to them. They have very good reasons to do so, such as their professional integrity, survival of the patient, and avoidance of medicolegal woes. The potential of having not done what *could* have been done, is the stark reality that the clinician faces.

In conflict with this is something that can seem far off and distant from the view of the hospital. But for some people in Treasury is another stark reality – that government funding is not unlimited. Unnecessary expenditure in healthcare necessitates cuts in other portfolios, higher taxes, sale of assets, or borrowing more debt (until default and economic collapse are on the cards). Staring at a sheet of numbers that sum to a deficit, and deciding what services to cut or sell, what taxes to raise, or potentially damaging the economic lifeblood of the state or nation and causing undue suffering to many – whether they realise it or not, is the impending reality of anyone managing a government treasury. There is no doubt that some of those decisions can even affect or claim lives.

These views and their tension meet in the middle at the hospital management. From one side is the needs of the patients and their advocates – the clinicians, and other stakeholders. From the other is the operating expenditure budget and the often-present savings strategy. It's sobering to think about what could be at stake. But it's not all doom and gloom – far from it - there is something we can do. We can manage this tension between the top-down and bottom-up views.

To do that, we should strive to:

- Improve the flow of information between each component of the healthcare system and government – providing iterative questioning, reframing and improvement when requests for information go from one party to another
- Substance – decision making should be based on evidence and analysis
- Options – explore and provide alternative approaches that could achieve similar outcomes
- Respect for Authority – everyone has their own expertise in their area – mutual respect and personal integrity goes a long way. we should give them the benefit of the doubt, try to see their viewpoint and share ours, and assume good faith.

Feasibility questionnaire – TDABC (Time Driven Activity Based Costing) model Radiology

This is a series of questions to examine the context of a site before embarking on the process of implementing a Time Driven Activity Based Costing Model. It is intended for radiology TDABC but could be applied to other departments. It is useful not just at the starting point but also when reviewing a model.

In terms of dedicated staff and time required for developing a model, SAMI's model took two FTE, six months' worth of effort, spread over two years.

Cost data – General Ledger baseline / cost data

- Are Radiology / NM department costs (particularly staff and consumables) separated out? Can they be identified?
    - Usually as cost centres for radiology / NM departments.
    - This is critical for top-down allocation of costs.
- Are mobile imaging, IR/INR costs separated out into separate cost centres? (this is a nicety.)
- Are non-rechargeable expenses and revenue able to be identified?
    - If you can identify them, then they can be removed from the "cost pool" that is allocated onto the activity.
    - Sometimes these will need to be included in the model "feed data" but isolated. Examples:
        - Fee for service (radiographers + nurses provided to other departments/theatre time), these are charged internally.
            - Activity – excluded from model activity feed (in SQL),
            - Expense – separated and removed from main activity expense
        - Fixed Research costs
            - Expense – moved to a research cost bucket, if not grant/project funded then allocated as part of the Teaching Training Research overhead

Activity data RIS – Radiology Information System

- Is there a full hospital RIS (containing all activity?)
- Are scans linked to the Electronic Medical Record (EMR) visits they are referred from?
- Is there a mature study/procedure classification?
- Does the RIS (and the PACS subordinate to it) store non-activity related data? For each, how can they be identified and excluded from the activity data? eg
    - retinal images uploaded by other departments to PACS,
    - externally provided images imported/uploaded to PACS for record/comparison purposes,
    - multiple entries that are just a component of a single procedure (nuclear medicine dose/scan points, CT workups/reconstructions)
    - activity covered by public health grants (for SA, we had TB outbreak XR Chest scans)
    - Private activity (may need to be counted depending on model specifics)
    - GP-referred and External Specialist referred, non-rebateable (e.g. scans not covered by MBS but ordered by external party, public electing outpatient with no encounter to link to.

- Ability to isolate tests for public patients versus private patients
- Record of time segments for patient journey – are these available? If so, statistics can be derived from them (eg medians), which creates a good "base point" for the time drivers.

Allocation and Relative effort

- Are there internal time-and-motion studies that can be utilised?
- Are there external time-and-motion studies that can be utilised?
- How many radiographers are required per scan, by modality?
    - This may depend by hospital and staffing approach – eg 3 staff for 2 CT scanners
- How many nurses work on specific modalities versus say a general bed bay nursing? Is there data available for this purpose, such as rostering information?
- Ability to (via meetings with unit heads and clinical staff) allocate staffing levels to various modalities
- Reporting times – from RIS and/or conversations with doctors
    - RANZCR studies
- Budgeting team – ability (and willingness) to reallocate current budgets based on new pricing model where specific departments might become quite expensive
- System that can extract monthly activity timely and easily
- Consider consequences / incentives – if costing say MDTs at patient level based on the meeting agenda/patient list, and MDTs often go overtime and add in additional unrecorded patients – this results in uncosted patients but Radiology / Nuclear Medicine still incurring an expense.
- Data analytics or business manager resources
- Reporting functionality (worst case Excel, ideally a Business Intelligence product like PowerBI or Tableau)