

High Tech Imaging Review

September 2021



ALLEN+CLARKE



He Kōwhiri, He Manaaki,
He Whakaora.
prevention.care.recovery.



Context for our work
Our approach- in two parts
What we learned
What we recommend



Allen & Clarke will:

- (a) Undertake an analysis of current activities in ACC's High Tech Imaging (HTI) Services: including underlying ACC cost/volume drivers, areas of variation, outcomes being achieved from the service and the HTI service flows and dependencies
- (b) Undertake a review of the initial comparative work undertaken in 2019, that sought to compare ACC's pricing and funding of these services with other international jurisdictions including exploring the validity of such comparisons and where valid updating the comparative data
- (c) Assist ACC to explore likely future service changes and trends, including technological advances, changing use of diagnostic imaging within the Health Sector and population demographics as they relate to current service coverage and access
- (d) Contribute clinical and strategic expertise: to help ACC develop a set of performance measures that provides visibility of client outcomes achieved by the HTI services
- (e) Identify changes to aspects of the HTI funding model to improve the financial sustainability of the service to ACC, including providing clear rationale for any changes proposed
- (f) Deliver to ACC a report which summaries key findings and recommendations from activities (a) to (e)

Our approach

Stage 1: Information collection and analysis

This stage focused on the collection and analysis of information relating to HTI activity and validation of the comparative work already undertaken (Health Sector Governance Board Update 2019), and assessed likely impacts on future service requirements based on current NZ and overseas trends.

Stage 2: Human Centered Design

In this stage our attention turned to engagement with key parts of the HTI service delivery in order to better understand the current delivery process, identify any critical decision points and gaps, and determine what design changes may be beneficial to future service delivery.



Stage 1: Information collection and analysis

Current state of play...

2019 Health Sector Strategy Governance Board Update

Problem to be solved:

The High Technology contract is over budget at the end of May 2020/21 year to date by \$83.3m (\$102.2m act vs \$19.3m budget). The end of year forecast is for an overpayment of \$31.0m (variance from \$19.3m bud).

Annual growth in actual expenditure (May 20 to May 21) is \$16.3m or 17.1%. This is made up of volume growth at 16.5%, and average claim cost growth at 1.5%.

Market Movement

In the 12 months through to the end of September 2020, ACC spent \$94.9m on high-tech imaging with an average of \$933 per claim.

Of this, just under a third (\$32.2m) was with Pacific Radiology, who are the dominant provider of our business.

Technology Movement

ACC's overall spend on HTI has increased from \$58.4m in 2014 to \$102.5m in 2020, an overall increase of 75.5%. The overall spend on HTI increased by 7.3% between 2019 and 2020. The increase in ACC spending remains consistent but at the lower end of international trends which have reported increases between 2 and 20% per annum.

In 2020 the use of MRI contributed to approximately 62% of all high-tech imaging claims and 70% of the total spend. There is very little difference in the proportion for 2020 (84% and 78%), 2019 (82% and 76%) and for the year up to June 2020 (80% and 75%). While the overall number of claims and spend is increasing each year this appears to be due to an overall increase in imaging modalities rather than any specific areas.

Pricing Models and Comparisons



A number of retail rates for both CT and MRI scans that are publicly available and published online by providers in New Zealand were reviewed and compared to ACC payment prices to see how they compare. The average difference was 17-53% lower than ACC's advertised retail prices. Some advertised retail prices did not include cost of combining modalities. Therefore, for certain procedures, ACC's payment pricing is lower than.



Comparisons to Australian Medicare

On a non-weighted basis the Medicare prices are 44% below the reimbursement paid by ACC for MRI scans and 39% below for CT scans.

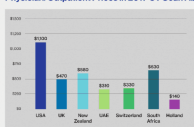
Procedure	ACC price	Medicare Price List (NZ\$)	% difference
R43 - MRI Lumbar Spine	\$799.67	\$475	40%
R63 - MRI Knee	\$799.67	\$431	46%
R66 - MRI Shoulder Girdle	\$799.67	\$431	46%
T40 - CT Skull	\$599.75	\$253	34%
T30 - CT Abdomen	\$599.75	\$253	34%
T41 - CT Cervical Spine	\$599.75	\$354	31%

Comparisons to International Market

Physician/Outpatient Prices in 2017 MRI Scan



Physician/Outpatient Prices in 2017 CT Scan Abdomen



Costs continue to rise...

ACC's YTD spend under the High Tech Imaging contract, as at the end of May 2020/21, is \$8.9m over budget (\$102.2m act vs 93.3m budget).

The end of year forecast is for an overspend of \$9.5m (\$111.8m fore vs \$102.3m bud). Annual growth in actual expenditure (May 20 to May 21) is \$16.3m or 17.1%.

This is made up of volume growth at 16.5%, and average claim cost growth at 1.5%.

Specifically...

In 2020 the use of MRI contributed to approximately 82% of all high-tech imaging claims and 75% of the total spend. There is very little difference in this proportion for 2018 (84% and 78%), 2019 (82% and 76%) and for the year up to June 2021 (80% and 75%).

And interestingly...

While the overall number of claims and spend is increasing each year, this appears to be due to an overall increase in all imaging modalities, rather than any specific area.

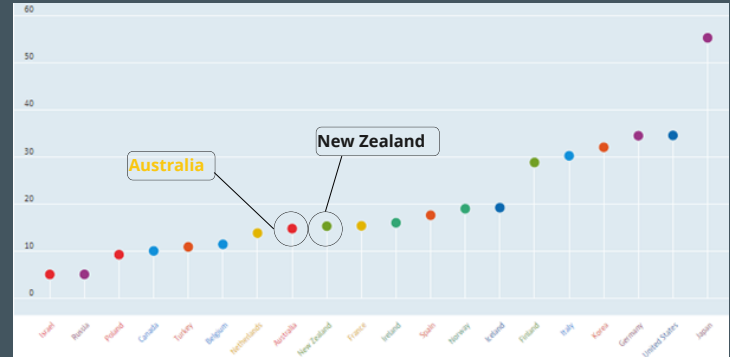
While our review of publicly available retail rates for both MRI and CT's found that ACC payments range from 17-53% lower than advertised retail prices, comparisons to Medicare (Aus) show Medicare's reimbursement rates are on average 44% and 39% lower than ACC's.



Drivers of volume...big picture



According to the Health at a Glance 2019: OECD indicators report, there is no general guideline or international benchmark regarding the ideal number of CT scanners or MRI units per million population. However, too few units may lead to access problems in terms of geographic proximity or waiting times. If there are too many, this may result in overuse of these costly diagnostic procedures, with little if any benefits for patients.



Data sourced from the Organisation for Economic Co-operation and Development shows that New Zealand sits in the middle of the pack when it comes to both the total number of MRI and CT scanner units per 1,000,000 population. Interestingly, New Zealand is marginally ahead of Australia in the number of MRI (15.31 vs 14.79 units per million people, respectively) yet Medicare pay on average 44% less than ACC.

Drivers of volume ...



Aging Population

Like much of the developed world, New Zealand has an aging population. In the years between 2000 and 2020 the percentage of New Zealand's population over the age of 65 increased from 11.8% to 15.6%. It is predicted that by 2046 this will be as high as 23%. It is expected that this trend is likely to remain as life expectancy continues to increase. Authors of a novel 2019 North American study investigated the High Tech Imaging rates across different populations. They found that for CT and MRI rates have been increasing across all age groups, with the an annual growth of between 2.2% to 4.9% occurring in the over 65-year-olds. [1]

Technology and certainty for physicians

"Why have imaging rates increased so dramatically for CT and MRI, despite their high costs? One obvious explanation is that the techniques have improved so much over time that physicians may be using them for concerns that might not have prompted imaging in the past. For example, CT's speed and resolution for detecting pulmonary embolism have improved so dramatically over the past decade that CT is now the primary method used to evaluate this condition, and this has undoubtedly contributed to the dramatic rise in costs associated with imaging of the chest" [2]

Future trends ...



AI and ML (Machine Learning)

Both are currently being developed/used to categorize or flag scans to speed up processing and, where needed, referrals to specialists.

Future applications of AI and ML are hypothesised to range from supporting more complex imaging protocols to mining data for new disease markers.

Blockchain

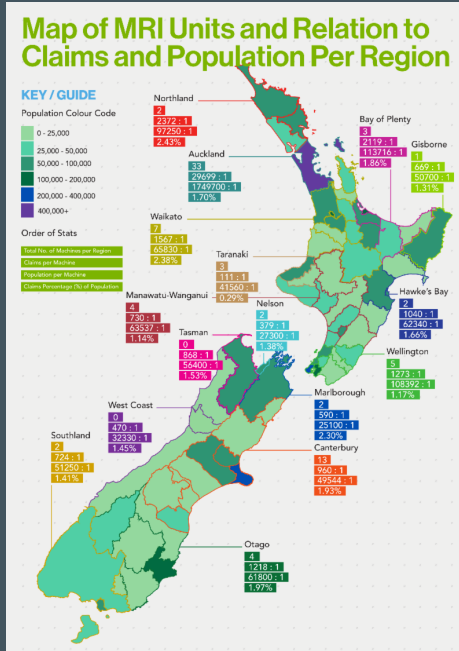
Blockchain has several uses and advantages in medical imaging applications. Its main utility is around data security and could help prevent data breaches that have occurred recently in health care and, if they do occur, enable continued functionality. It also has the potential for increased cyber and data security in terms of data sharing which may support innovation in real-time image processing and advances in interpretation, such as the use of ML.



One point in particular...

One area of specific interest for ACC

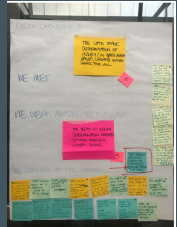
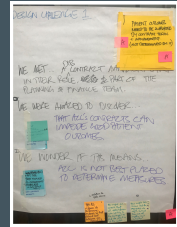
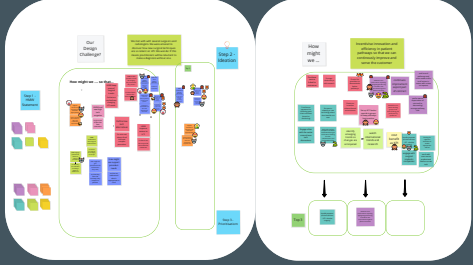
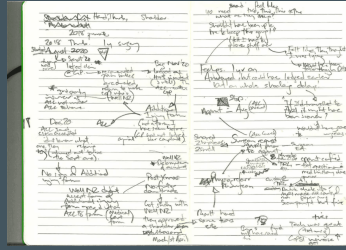
Does proximity to HTI machines increased the number of scans performed? Our analysis showed that not to be the case but rather the relationship of size of population to no. of scans was an influential factor.



In attempting to answer this question we were surprised that we were unable to find a "national inventory" of MRI machinery so in order to complete this work we created one - shown at right. Note this is MRI specific only and based on publicly available information.



Stage 2: Human Centred Design



One-on-one empathy interviews with sector participants

Raw data turned into process maps and insights distilled for use in problem definition

Insights then used to determine the Design Challenges (or Problems to Solve)



Some of the more interesting outtakes...

- *HTI volumes and demand will continue to grow as they are used as a key tool for both diagnosis and supporting treatment options. ie surgery planning, technology advancements ie implant design
- *And as such, HTI's are no longer the exception and are fast becoming the norm
- *The HTI contract is an important tool in achieving great patient outcomes but not an outcome in itself
- *The current HTI experience is inconsistent and can be both confusing and stressful for all sector participants
- *The impacts of delays - to the patient and overall cost (e.g. GP referrals pilot potential for \$1mill savings)
- *The degree of frustration and at the same time the willingness to be engaged in the discussion on HTI delivery
- *The innovations being used to deliver against current performance measures ie overnight UK based reporting on HTI imagery
- *The different language used throughout process when referring to patients (ie customer, patient, client) and each has differing connotations

Key themes...



Design challenges...



Patient outcomes need to be supported by the contract terms (not determined by it)

How can ACC be more flexible in its approach to HTI?

The late stage of determination of injury (in grey area cases) creates extra work for all

Normalisation of HTI tech use - both demand and supply side expectations, and "very hard to turn that ship around"

Complexity and cost of staying ahead (or even up with) advances in technology

We met... with a number of radiologists and surgeons.
We were amazed to discover... the extent to which customers now expect an HTI.
We wonder if this means... that patient expectations are being set before enough is known about the patients probable pathway?

We met... with a patient and several members of the HTI sector.
We were amazed to discover... there is no clearly defined pathway for patients in need of an HTI.
We wonder if this means... that getting an HTI is unnecessarily stressful for all involved."

We met... with several surgeons and radiologists.
We were amazed to discover... how new surgical techniques are so reliant on HTI.
We wonder if this means... practitioners will be reluctant to make a diagnosis without one.

We were amazed to discover... that ACC contract requirements can impede good patient outcomes
We wonder of this means... ACC are not best placed to determine contract measures

We were amazed to discover... that the delay on injury determination created tension amongst the sector participants
We wonder of this means... we should prioritise clarity of diagnosis the the earliest opportunity



Ideation...

Brainstorming

Consolidation

Prioritisation

Prioritisation criteria for prototypes:

- * Patient outcomes focussed
- * Earliest possible determination for the patient
- * Best imaging used as early as possible in process to support both diagnosis and determination (where appropriate).
- * Co-designed performance articulation and best practice

Prototyping...

Aim = test for weaknesses

Development of concept and scenario

Trialling, feedback and iteration





Prototypes and Recommendations

Prototype 1

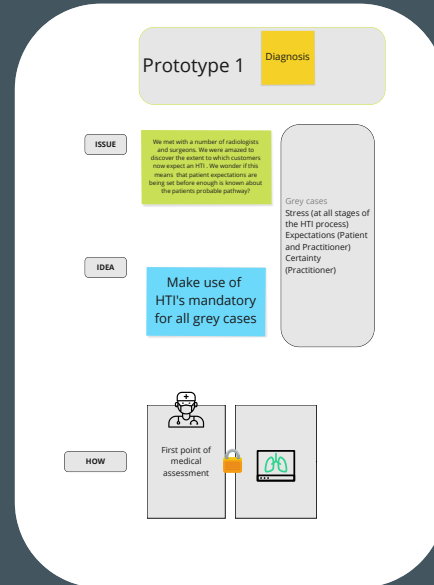
Prototype 1 was aimed at...

Grey cases - those hard to diagnose/ cases. These provide the greatest opportunity for improvement of patient outcomes

***Stress** (at all stages of the HTI process)

***Expectations** (Patient, Practitioner, Provider and ACC)

***Certainty** (Patient, Practitioner, Provider and ACC)



Recommendation 1

Our recommendation : HTI's become mandatory for all grey cases

"Early diagnosis is the fastest path to definitive care"- Radiologist

Key features

- *Supports ACC's core focus regarding early return to independence (* Statement of Intent)
- *Long run reduction in costs due to reduction in other modes of imagery use, worker compensation payments etc
- *Quicker diagnosis and determination of treatment, providing certainty for the Patient
- *Reduction in stress at all stages of the HTI process
- *Certainty of treatment pathway for Practitioner

Assumptions

- *Definition of grey case is where first medical assessor cannot or is not confident of making a diagnosis
- *Ability to order MRI's (where clinically appropriate), granted to broader first assessor categories
- *Rollout will be phased (ie extension of GP trials) and has dependency of further training in imagery reading

Prototype 2

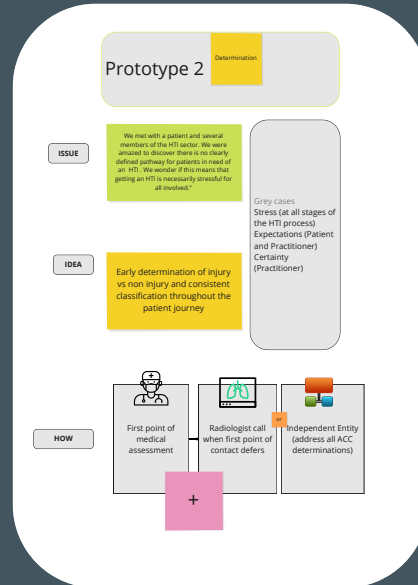
Prototype 2 was aimed at...

Grey cases - those hard to diagnose/ cases. These provide the greatest opportunity for improvement of patient outcomes

***Stress** (at all stages of the HTI process)

***Expectations** (Patient, Practitioner, Provider and ACC)

***Certainty** (Patient, Practitioner, Provider and ACC)



Recommendation 2

Our recommendations:

- *Establish an independent service to review HTI imagery (and other relevant information) to determine injury or non-injury causation as early as possible
- *Once determined that there is a consistent application of the classification throughout the patient journey

"The longer that it (lack of determination) goes on the worse it is for the patient"- Radiologist

Key features

- *An independent rapid determination service- provided by qualified third party practitioners and funded by ACC
- *Once determination is made it is funded by ACC - ie automatically covered under the HTI contract
- *Supports ACC's core focus regarding early return to independence (* Statement of Intent)

Assumptions

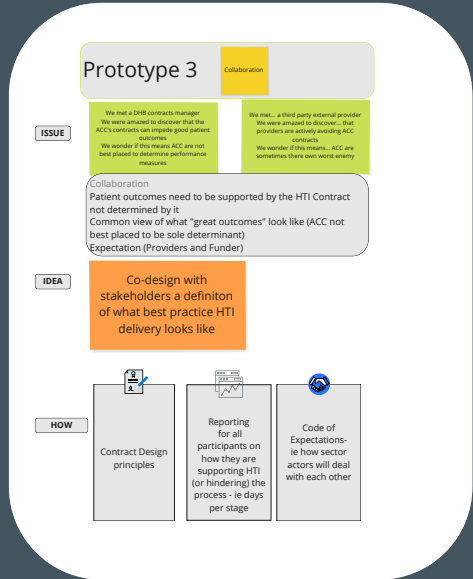
- *Definition of grey case is where first medical assessor cannot or is not confident of making a determination and requires a specialist opinion
- *Once a determination is made, it is not challenged
- *Once determination is made it is funded by ACC.
- *Reduction in mediation and court costs related to disputed cases

Prototype 3

Prototype 3 was aimed at...

Sector collaboration

- *Patient outcomes need to be supported by the HTI Contract not determined by it
- *Common view of what "great outcomes" look like - ACC not best placed to be sole determinant
- *Common expectations (Providers and Funder)



Recommendation 3



Our recommendation: Engage key stakeholders involved in the broader HTI process (providers, radiologists, DHB procurement officers, surgeons, patient voice) to collaboratively design the new HTI contract.

Contract Design principles

- *Collaborative design of performance articulation and best practice
- *Contract provides for agility, in order to provide the best outcomes for the patient
- *All participants given equal weighting
- * Incentivise innovation and continuous improvement, in order to provide the best outcomes for the patient

Code of Expectations

- *Code of expectations would show how the key 'participants' in the end to end process of HTI provision should act on a day-to-day basis. It reflects the core values, and direction and expectations of each party (including patients).
- *This would be collaboratively designed.
- *While there are differing views of the participants, there is a common focus- the health and recovery of the patient

Reporting and Process Insights

- *Provided to all participants showing how they are supporting HTI (or hindering) the process - ie elapsed days per stage, surgeon wait times, utilisation of equipment, key insights and trends, and impacts on high level patient outcomes.

Contract Terms

- *Term - 3 years with an 18 month reset to account for tech and or procedural innovations (not just price increases)

Assumptions

- *Collective knowledge of the end to end process and the impact on the patient
- *Establishment of strategic partnership versus parties to a contract
- *Active use of current ACC reporting requirements and data



Our recommendation:

- *All measurements are aimed at **and reviewed against** maximising customer centricity, ie enabling the Patients earliest return to (their) normalcy
- *Retain the current measurements of cost effectiveness, timeliness and reporting requirements and add **agility and innovation** categories.

"Better and quicker outcomes for the patients, these need to be reflected in the measurements"-DHB Procurement Officer

Key features

- *Patient outcomes focussed
- *Collaborative design of contract measures and what success looks like from a contract implementation perspective.
- *Provides incentives and (degree of) certainty for providers investment in best fit -for-purpose technology and process optimisation

Assumption

- *Collaborative design approach adopted in developing the contract, key measures and code of expectations

Thank you



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No Whosone.
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Appendix:

Summary of key insights per role gained through our interviews

Patient/Customer/Client

ACC EPM

GP referral pilot lead

Orthopaedic Surgeon

Radiologist x 2

DHB Procurement Officer

Key insights from the interviews per role in the end to end process



Customer/Patient/Client



Waiting 4 months for a specialist appointment it was "shocking". And when you ring up to ask they tell you that they are "away at conference or holiday or they are dealing with the covid backlog".

The good thing is that the scan was done prior to seeing the surgeon so you have to go back and forth.

"Oh yeah there are delays all along, due to the amount of referrals going into X location and the availability of the machines". "You just accept when you live here that you will have to wait" . "probably would have been faster if I had gone the DHB's".

If there was MRI imaging closer to the time of the injury then it could clear things up.

It probably would be easier if GPs can take MRI referrals, only 1 in X location as he deals with sports injuries. Would improve diagnosis and the onus would be on GP to confirm injury or not and then they could

"I felt like they thought I was lying", "you need to do this, you need to do this" She felt she had done all the right things.

So it will be a year till you see the surgeon, how does that make you feel? "It annoys me a little bit, some of it is my own fault, I could have lodged things a little earlier".

"I shouldn't have been up to me to keep chasing up". As far as she was concerned she has lodged with GP (after physio had said the best place was for her to go to GP to get it lodged) then form was lost, and she felt that she had to prove herself.

We need to ensure that we get the "right spend on the right thing"

The contract does not have good measurements. All are timeliness related and at a granular level, "which aren't really meaningful", and do not relate to outcomes.

New ways of working and the 'transformation changes' mean more systemic issues vs customer issues. As I tell my boss about 90% of the day is spent dealing with issues.



There are some concerns with a potential supplier and a potential conflict of interest (surgeon owned).

"ACC has become faceless", with the new business model. So EPM's are now the face that is out there, so time is taken up dealing with that.

Determination has always been an issue. "They (providers) don't feel it is their role to determine non injury vs injury (status), they want ACC to do it they just refer"

Not managing the expectations of clients. As they get x2 injections free then they have to go for surgery but ACC won't fund the surgery and from a client perspective that doesn't make sense.

If one thing could be changed, while there would be more administration work involved with this, all injections should require prior approval.

Success of the GPSI pilot due to clinically led initiatives (Led by Doctors).

An estimated \$1 million in savings gained from the GP referral pilot

GP Referral Pilot



The pilot did change number of MRI's (they have moved within the process).Unlike what occurred in other countries

X location medical workforce concerns . 80% will retire by 2030 (next 9 years) and 45% are British (and trained in London).

One of the successes of the pilot was the amount of time and anxiety that is reduced for patients, "especially the young and those in rural areas".

What is good is the triaging system. GPs that are trained in MKS/MRI that looks at referral form to confirm pathway, i some practices it is a radiologist. "So the quality is high".

When people have health problems they want to know and have faith in the person treating them. Treated by the right people with the right treatment options.

Prime purpose is to serve the customer. They need help and his objective is to help them

Years ago, it was common in rotator cuff to operate on just ultra sound. But now more likely MRI .

Each week his PA goes through all referrals. when a GP has written down, "get MRI" she will highlight this and he checks this before referral. Estimated out of 20 new patients he sees about 20% would have that written.

If he operates on 20 people, 1 of these you "get in there and it looks different" and you need a different pathway. Therefore 1/20, although he was guessing numbers/operation is potentially wasted, unnecessary. Having certainty of approach of surgery and need of surgery should be more efficient in the long run .

He has "smoothed pathway" by quick, responsive report reviewing and communicating to patients (process).

It is now normalised for surgeons to always get a MRI prior to surgery.

An MRI doesn't determine causation (for ACC eligibility) as changes could imply a recent or long standing issues.

Surgeon



Most patients who have surgery have scan and used for diagnostic purposes.

"physio's and GP's don't tend to have a level of appreciation around what is normal, what is significant", [related to reading MRI reports]

It is normalised for patients to want an MRI. "MRI is seen as a necessity and a panacea". If doctors/physio's/ or even radiologists mention MRI on any forms used with patients, they expect it .

"for every decade of age there is an extra paragraph of an MRI report"

He wonders whether ongoing education for the primary carers ordering tests will be adequate. Contingent upon people knowing what they are doing and they need to have continual education for it to be adequate for it to work.

The software that is used now for implants (to make the implants) you need the MRI image detail to input into the software/build of the implant .

The hardest conversation is an MRI is mentioned (somehow)prior to meeting surgeon and the belief system about what is wrong and whether MRI is needed. "Hard to talk down".

Wishes that with HTI reports there was some attachment to give some perspective of frequency of findings against age to indicate to both referring doctor and patient what is normal ie graph of percentage of rotator cuff tears against age



Radiologist



Working in the private sector there is a lot of interplay with insurances and ACC. But then that has implications. Private insurances will make you go through the process to get turned down by ACC before they will cover it. This can lead to delay and stress for the patient.

ACC plays an important role in providing these services, taking the "load off hospitals" and keeping patients out of hospitals

A key part of the approach in NZ and Australia systems is that none of the referrers can be involved with scanners (so it is independent.)

Determination- It is everyone's role and it is difficult decision. ACC has been fantastic in helping and it is a success.

In relation to the RIS (Radiology Imaging Service) - "you people don't understand how complex it can be"

Also as more younger surgeons come into the industry they are more used to using imaging for diagnosis.

Would like to "tidy and speed up the approval process. It would be enormously beneficial to both staff and patients".

Purpose of role is about getting customers back to where they were, through the highest quality service so that referrers make a diagnosis quickly.

"Actually, the people on the West Coast do get preferential services (and there are some doctors that are concerned about this), yes they have to travel but they don't miss out."

There is "a lot of gray" (to diagnose). It can be very clear cut with imaging. But in other circumstances you have to use other factors and "marry together".

There is also increased awareness of the use of imaging and acceptance in terms of diagnosis from both patients (customers are demanding it) and surgeons. Some surgeons "won't operate without it otherwise they can get the blame".

There have been massive advances in imaging technology and the ability of scans to make a diagnosis.

We (NZ) is the only jurisdiction in the world that has to prove trauma. There are a lot of terminology in the literature (case studies) which doesn't help and it is very hard to tell what is injury and from injury (note: he used the term trauma vs non trauma) as it is not a consideration overseas.

Younger surgeons are now demanding it [imaging].

In relation to wait times for customer to see surgeon or surgery "might not be a bad thing, as the patient can spend time doing prehab"

In relation to not giving patient choice about provider it "breaches the bill of rights"

Considerations when deciding options for provider (from referrer), patient choice, referrers recommendation, patient convenience

"RIS are complicated and expensive to administer". Have to consider uptime (is time available), security and confidentiality of patient information, [that] referrers can use and access the images. Overall quality and availability and the maintenance "of all that".

In the 90's there was limited use of imaging for diagnostic ability. The example of surgeons and knee surgery - "going in and cutting a small piece" to diagnose.

An accurate initial diagnosis actually saves ACC significant money in the long term as it ensures appropriate care and reduces treatment time off work etc and allows tailoring of treatments that have a high chance of not being either. Don't just trial and error and find 3-4 months down the track off work/missing an improved and need to treat again.

I wonder if ACC could be more open to alternative arrangements. Give the examples where the most appropriate and faster treatment/diagnosis is provided certainly for patient and the treatment was made of 2 scans, both x ray and MRI. They asked ACC to change the process - they would charge less for these scans and potentially overall cost would be lower as would involve less time off work for the patient if they were cleared of a fracture) but ACC would not agree.

Two most important factors #1 Quality accreditation (most providers do, more an issue in low intensity providers) #2 Arms length referrals (protocol). At the moment referrers send requests as independent provider to provide scan. There is no financial relationship between any parties (referrer, surgeon, provider).

We want ACC to take this seriously, we don't want the programme exploding [demand wise] and ACC saying this is too expensive. The risk is the reaction (from ACC) will lead to restricting MRI usage (e.g. in Australia, say under 45\$ only).

My wish is that we could "break down barriers to progress through the system faster", "that is why the GP referrals is good". You want the patient to turn up to a surgeon with everything they [the surgeon] needs to make a decision [about next steps].

Although it does have its disadvantages and there are other customers that have suffered [as they are not covered]. Such as those with rheumatoid arthritis and tumours and "it does make us (surgeons) uncomfortable".

There is a huge amount going on with the health system and demand is greater than ever. For the non ACC work "we are sending reports to the UK overnight", so using other countries to support demand.

"The (GP pilot) wasn't looked at from a whole of system perspective." If they (DHBs) had been involved with PHO's and ACC it could be more efficient.

"ACC isn't covering their [dhb's] costs" re: MRI's. "Noise I hear from other DHB's is about funding not [ACC] service".

Role sits in the planning and finance space, "which is unusual as similar roles sit in finance space as to maximise ACC revenue".

You need to be thinking about whole of patient flow and what are the key measurements, such as time back to work.

"The GP pilot caused a bit of angst with PHO's in X location, but it had a better outcome for the patient".

Public costings is all average of averages "so not very accurate". "I want ACC to review costings"



"DHB's are interested in the whole of health and the contracts need to reflect where health is going, not the other way round".

"we try not to do any ACC work where possible in order to manage capacity at the hospitals"

"better and quicker outcomes for the patients and these need to be reflected in the measurements"

"It is good that we are having this conversation as DHB's in the past haven't been included financial contract negotiations or variations".

When you look at the inputs to provide costings to ACC, "which have all gone up" such as salary costs, and the imported materials (from Aus) for nuclear bone scans (which has gone up from COVID impact) there hasn't been any increase in funding.

"Radiology is costing a lot of money" and given the state of the DHB finances they are looking at all the contracts.



Acknowledgements

[1] Smith-Bindman R, Kwan ML, Marlow EC, et al. Trends in Use of Medical Imaging in US Health Care Systems and in Ontario, Canada, 2000-2016. JAMA. 2019;322(9):843–856.

[2] Smith-Bindman, R., Miglioretti, D. L., & Larson, E. B. (2008). Rising use of diagnostic medical imaging in a large integrated health system. Health affairs (Project Hope), 27(6), 1491–1502.

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