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Market-based control for patient safety

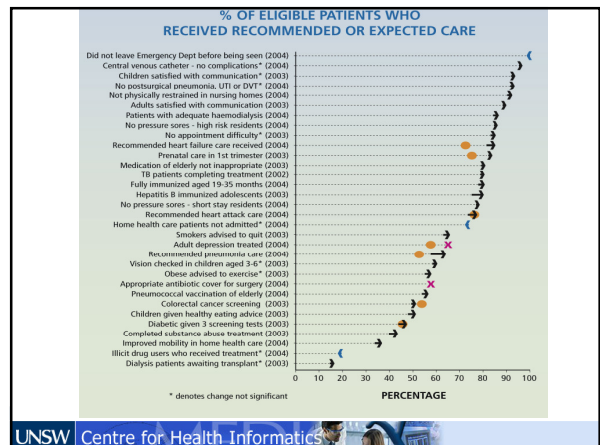
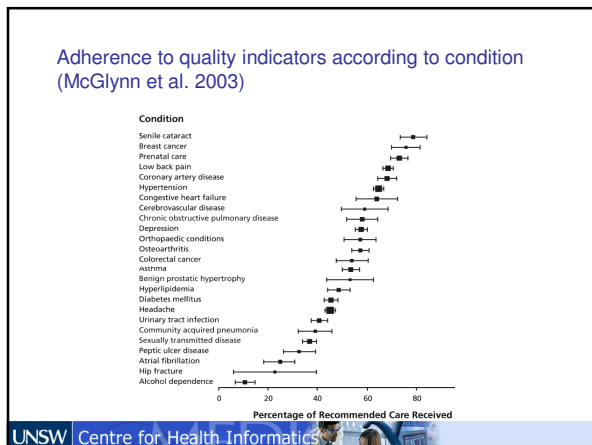
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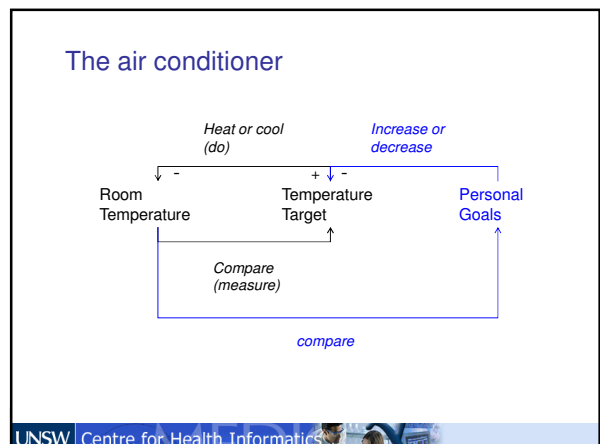
Safety and quality

- 10% of admissions to acute care hospitals are associated with an adverse event (ACSQHC 2001).
- About 2% of separations associated with serious adverse events causing major disability (1.7%) or death (0.3%) (Runciman et al. 2000).
- 1 million general practice encounters/year in Australia involve an adverse event (AIHW 2008) [~38/GP]
- Adults receive recommended care just over half the time (55%) and children just under half the time (46%) (McGlynn et al., 2003)



Control systems 101

- *Feedback-control systems* try to optimise system states under varying conditions
- Think of an air-conditioner that:
 - has a **programmed target** which is ideal temperature
 - measures temperature in a room
 - heats or cools in response to deviations from the target





Market-based control (MBC)

- MBC systems are designed to shape the behavior of a group of agents through uniform incentives and penalties
- Example: Behaviour change program to encourage a group to exercise more
 - Set a target e.g. walk 5 k/week
 - Issue 'currency' e.g. 1 certificate per km over your target
 - If you miss target you must buy certificates to make up difference (the penalty)
 - If you exceed target you can sell your certificates (the incentive)
 - Price signal should effect behaviour change
 - Over time people should reach an equilibrium state where everyone walks at least 5k a week

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Making MBC work – setting the target (1)

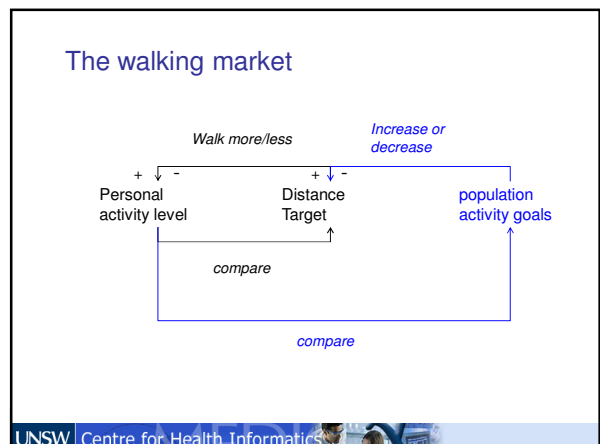
- It should be "cheaper" to exercise than to buy certificates, otherwise the change signal is too weak
 - Price is not a 'true cost' of not exercising, it's a change signal
- Supply and demand determines the traded value of a certificate
- Global target setting: the challenge is to set targets so there are just enough certificates.
 - Too many -> little incentive
 - Too few -> risk of a bubble, or other market distortions

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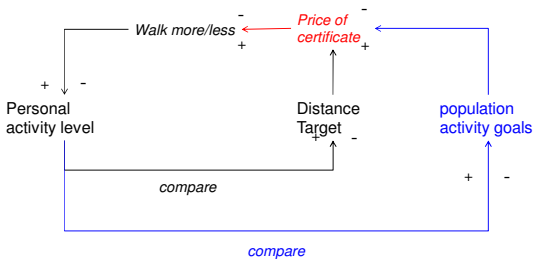
Making MBC work – setting the target (2)

- Local target setting: Agent heterogeneity can be problematic e.g. marathon runners!
 - So targets weighted by how much individual needs to change e.g. 1 certificate per 20k, else distorts market.
 - But low targets eg obese, "grandfathers in" unfairness too, which can destroy incentive to change or be a license to print money
 - 'Fairness' is relative to market goal (increase overall fitness) and not personal fitness ('why treat me differently?')
- 2nd loop control: By measuring number of trades and prices, market regulator monitors and adjusts settings e.g.
 - increase walking targets as population gets fitter
 - modify individual weighting scheme
 - i.e. MBC targets can dynamically adapt to ensure desired outcomes

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The walking market – price is the signal to change



Examples of MBC in action

- US Federal Clean Air Acts 1970, 1990 successfully used MBC to control CFCs
- Kyoto and carbon trading
- Resource allocation in telecommunication networks (software agents)
- Structural control during earthquakes

Can we use MBC to make healthcare safer?

- Given slow progress in patient safety, can MBC offer us a new way of thinking about safety improvement?
- We have tried incentives e.g. pay for performance
- We have tried penalties (e.g. 'never events')
- MBC a uniform way of integrating incentives, penalties, and adaptive target setting

How would a safety market work? (1)

- Create a permit 'currency':
 - Define a basket of preventable adverse event classes (PAEs) for which we have good indicators e.g. falls, hospital acquired infections – will be sector specific.
 - A "good indicator" is highly coupled to clinical processes we want to change
 - Pick a common measure of PAE cost e.g. length of stay (LOS)
 - Calculate relative impact of different PAEs on LOS, so we have a common 'currency' in the system e.g. 1 day extra stay = "1 safety permit"

Top 'natural' categories of adverse event in hospital

*A wide variety of PAE causes can be collapsed into a smaller basket of 'natural' outcome categories

*Each category associated with a cost (additional days length of stay).

*From Runciman et al, *Quality and Safety in Health Care* 2002;11(3):224-229.

*This analysis of 15,000 hospital admissions found 25% of PAE resources were expended on 11 most frequent categories, 50% by top 45.

Top Principal Adverse Event Category	Mean additional length of stay (days)
Ongoing pain/restricted movement following back surgery	22
No, delay, inadequate investigations ischaemic heart disease	13
Wound infection following peripheral procedure	11
Incisional hernia: post-procedural	10
Postoperative bowel obstruction/adhesions	13
Injury due to fall in nursing home	12
Failed/blocked/ruptured/ aneurysm, vascular grafts	13
Recurrent incisional hernia	9
Pulmonary embolism postoperatively	8
Wound infection following abdominal/retroperitoneal/pelvic procedure	5
Catheter related urinary tract infection	5

How would a safety market work? (2)

- **Establish system-wide targets** e.g. reduce LOS caused by PAEs by 5% per annum.
 - Use estimate of the current baseline PAE rate, system costs, and **ability of system to change**, set a global target to progressively reduce PAE rate over time
- **Allocate organisational targets.** For clinical organisations, estimate their current baseline PAE rate and set an appropriate harm reduction target.
 - Organisations must find ways to meet that target.
 - If there is **heterogeneity** amongst organisations we might want to **locally weigh targets** e.g. casemix-adjustment.

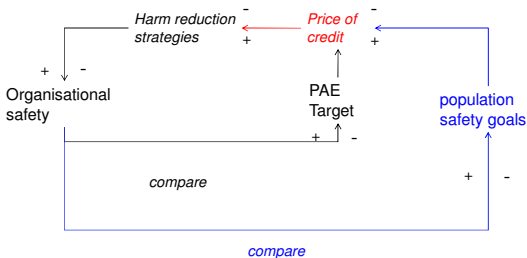
How would a safety market work? (3)

- **Create a safety market for trading safety credits.**
 - Organisations that reduce PAE rates below target can sell surplus credits to support clinical care, further improvement.
 - Organisations that miss targets must purchase credits to meet target, or pay the regulator for credits at a set price. Either way safety is now a 'bottom line' cost that can't be ignored.
 - Failure to comply with program generates a large penalty.
- **Allow for accreditation and certification and audit of authorised third party organisations.**
 - New organisations can independently initiate verifiable harm reduction projects to generate new credits. E.g. community programs, e-health systems.

How would a safety market work? (4)

- **Police the market through an auditing mechanism.** Audit need not be universal, but will need to be visible, credible, perhaps random to ensure compliance, and responsive to attempts to distort, cheat or evade.
- **Monitor market to ensure credit prices provide a clear signal for behaviour change and modify targets (and hence credit supply):**
 - Not too high so that paying for credits harms organisations and compromises normal care
 - Not too low that buying credits is a sustainable way of coping with missed targets
 - Does not result in some organisations gaming the system, or benefiting because of incorrect weighting

The safety market



And do people think this is a good idea?

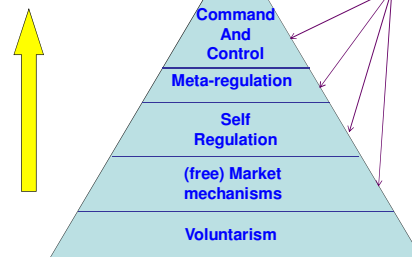
- "I see little likelihood that anything like it would ever be adopted".
D Meltzer *Qual Saf Health Care* 2009;18:86-87
- "I am not optimistic that the proposal will see the light of day".
C. Donaldson *Qual Saf Health Care* 2009;18:87-88
- "For every complex problem there is an answer that is clear, simple, and wrong".
RG Thompson *Qual Saf Health Care* 2009;18:83-84.

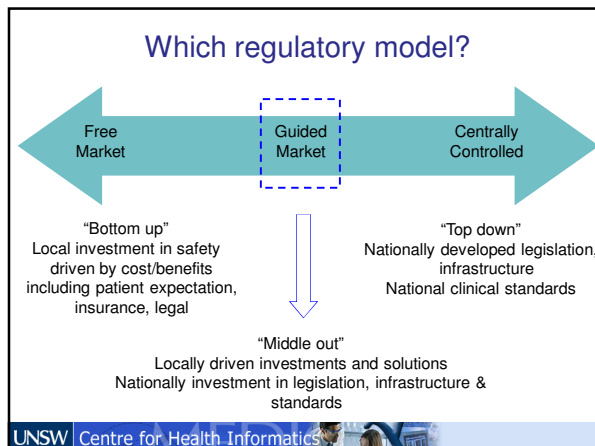
Arthur C. Clarke's 3 laws of prediction

1. When a distinguished but elderly scientist states that something is possible, he is almost certainly right. *When he states that something is impossible, he is very probably wrong.*
2. The only way of discovering the limits of the possible is to venture a little way past them into the impossible.
3. Any sufficiently advanced technology is indistinguishable from magic.

Regulatory Pyramid

(Braithwaite, Healy et al, 2005)





Ground zero – voluntarism (public) and the 'free' market (private) co-exist

0

- The status Quo pre 2000
- **Tools:** Voluntary use of clinical protocols, self monitoring, continuing education, new technology
- **Drivers:** media (quiet), voters (happy), champions happy (quiet) profits up, insurance premiums down
- **Criticisms:** Safety not measured, episodic case reports are only indicators, unaddressed systematically, no resources allocated
- **Analysis:** It doesn't work. PAE rates well known: 10% admissions, 3% serious, 1.5% deaths

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Level 1 - Something must be done ...

1

- The last decade: Governments tasked special agencies to improve patient safety
- **Tools:** Agency funds, Academic evidence and tools e.g. critical incident databases, RCA; agency programs target 'low hanging fruit' or pilots
- **Drivers:** champions, pilot programs bring resources and kudos to participants
- **Criticisms:** Safety now measured, but not systematically; resources small compared to problem scale, picking winners always problematic
- **Analysis:** More about learning than doing. Outcomes appear to have been modest at best. Getting jurisdictions, organisations or clinicians to come on board difficult as no real incentives or penalties for unsafe outcomes

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2 – Formal (targetted) safety controls

2

- Today's 'bleeding edge' programs. Select specific outcomes or behaviours and institute monitoring and feedback signals
- **Tools:** Clinical indicators, a price on unsafe outcomes, enshrine in public legislation or private contractual arrangements
- **Drivers:**
 - Direct Financial drivers - **Incentives** – e.g. pay for performance; **Penalties** – e.g. "never events"
 - Indirect Financial drivers e.g. publish performance publicly; **Incentives** – e.g. reputation, attract business; **Penalties** – e.g. reputation, lose business
- **Criticisms:** Safety now valued (\$), systematic measurement of selected indicators, but still picking winners. **Piecemeal - incentives and penalties not integrated. Picking winners a zero sum game e.g. P4P.**
- **Analysis:** Good evidence that results in improvements, but rate and amount of change not great.

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3 - Formal (generic) safety controls

3

- A safety tax. Move from picking winners to treating 'safety' in a more universal way, with broader monitoring and feedback signals
- **Tools:** A broad basket of indicators and \$ value, tax poor performance
- **Drivers:** Minimize 'tax' by minimizing outcomes in basket.
- **Analysis:** Avoids distortions of picking winners as now measuring a broader set of indicators, and not prescribing specific harm reduction strategies. More likely to meet local needs.
- **Criticisms:**
 - Like a carbon/consumption tax, costs clear for providers, but outcomes unclear for public i.e. tax rate is a guess about what is needed, and can't recast tax rate quickly i.e. not a very dynamic system.
 - Is the basket of indicators a good measure of general system safety?
 - Agent heterogeneity may require moving from a flat tax to weight-adjusted tax (e.g. casemix). Exemptions or variations from 'flat' tax levels could become a major problem, subject to lobbying, benefiting the powerful.
 - Drivers are cost minimizing, no positive rewards for doing well.
 - External innovators not motivated to engage.

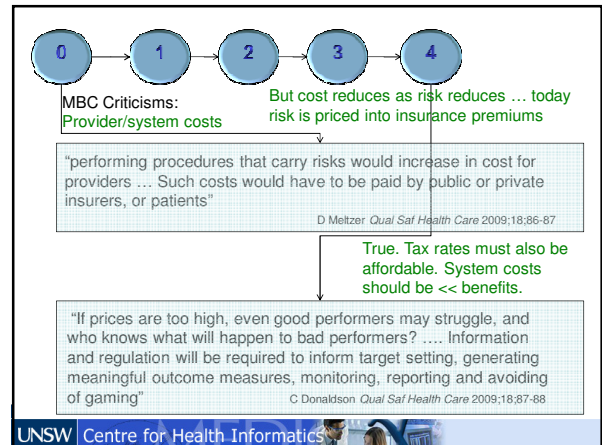
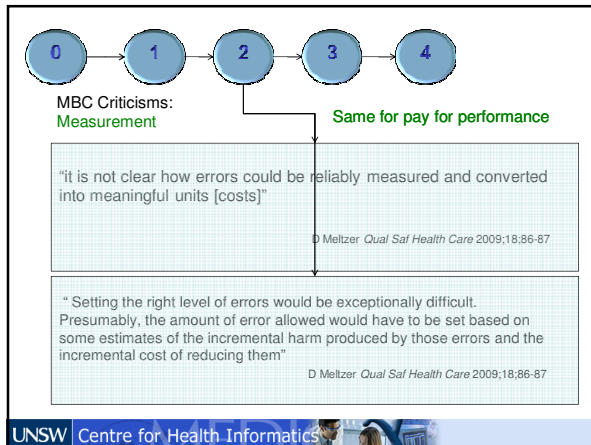
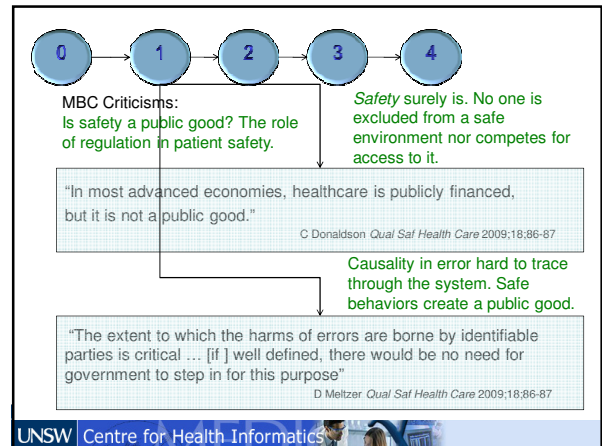
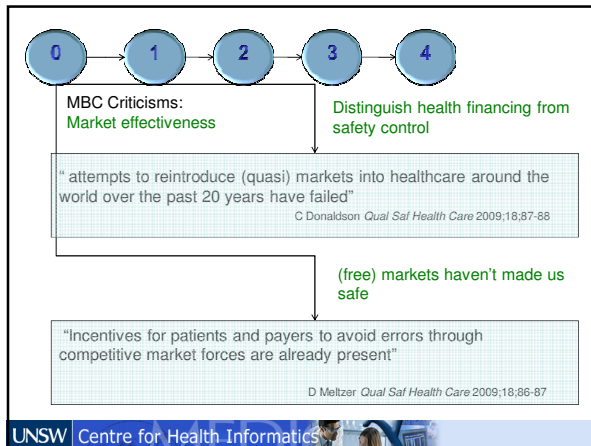
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4 – Market based control

4

- **What we add in further:**
 - Blend incentives (earning credits) as well as penalties (buying credits)
 - Allow accredited third parties to enter, who bring innovations and investment (people, skills, \$)
 - Unlike a tax, outcome (target) is clear
 - The 2nd loop makes *system dynamic and self adjusting* - market price and supply of credits are control signals to the regulator to adjust market dynamically
 - Can address agent heterogeneity directly by creating provider specific targets.

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One take home message ...

Engineers are from Mars and economists from Venus

Take home messages

- The 'market' word is a distraction. So is 'control'.
- MBC is just one point in a continuum of system control model designs
- It is a journey we make in stages as well learn about component elements
- Many anxieties are not unique to MBC but are embodied in less complex control models
- Try and set aside 'shock of the new' and ask evidence based questions

What we think should happen next

- Lets make 'market-based control' an active area of health services policy and informatics research:
 - Look at indicators with a new role
 - Look at blended penalty/rewards systems
 - Computer simulations help understand impact of number and cost of credits, and casemix adjustment
 - Small trials to get experience
- Look to other applications beyond safety



The market-based safety machine?

"I suppose the process of acceptance will pass through the usual four stages:

*This is worthless nonsense,
This is an interesting, but perverse, point of view,
This is true, but quite unimportant,
I always said so."*

JBS Haldane *Journal of Genetics* 1963; 58(3), 464.

Thank you

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