



Australian Government
Department of Industry and Science

Business
Cooperative Research
Centres Programme



Future of Medical Research

“From Bench to Bed-side”

Translational Research Outcomes from
Australia's Medical Sector CRCs



Professor Bob Cowan

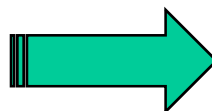


Future Determinants of Health

- Health is not just presence / absence of illness or injury
- now viewed as **physical, mental and social well-being of individual**

MEDICAL DISORDER:

What's wrong with the system or organ



PERSONAL DISABILITY:

What a person cannot do as a consequence...

- Medical research / treatment concerned not only with extending life, but more importantly the quality of that life.

Future Directions in Health - 2040

1. Gamifying health treatment tracking
2. Empowered patients as partners with caregivers
3. Telemedicine & remote care, including robotic care & medical decisions via AI
4. Genomics and personalised medicine
5. Body sensors (nanobots)
6. 3-D printing and growth of new tissues/organs
7. Re-thinking the medical curriculum & communication
8. Medical bionics

Health is Big 'Business'

Figure 2.2

Health expenditure to GDP ratio (per cent)



Source: AIHW health expenditure database.

Total health expenditure to GDP ratio, 1986-87 to 2011-12

2011-12 = \$140.2billion
9.5% of GDP

Figure 2.3

Health to GDP ratio (per cent)



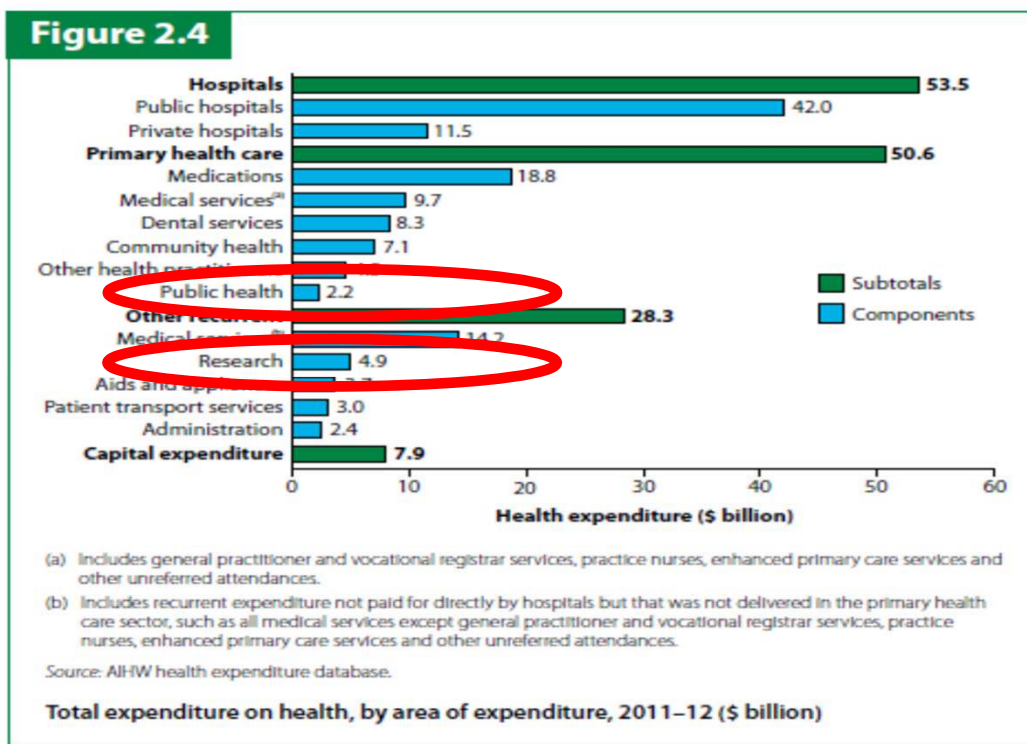
Source: AIHW 2013a.

Health expenditure as a proportion of GDP, selected OECD countries, 2011



Source: Australian Institute of Health and Welfare 2015

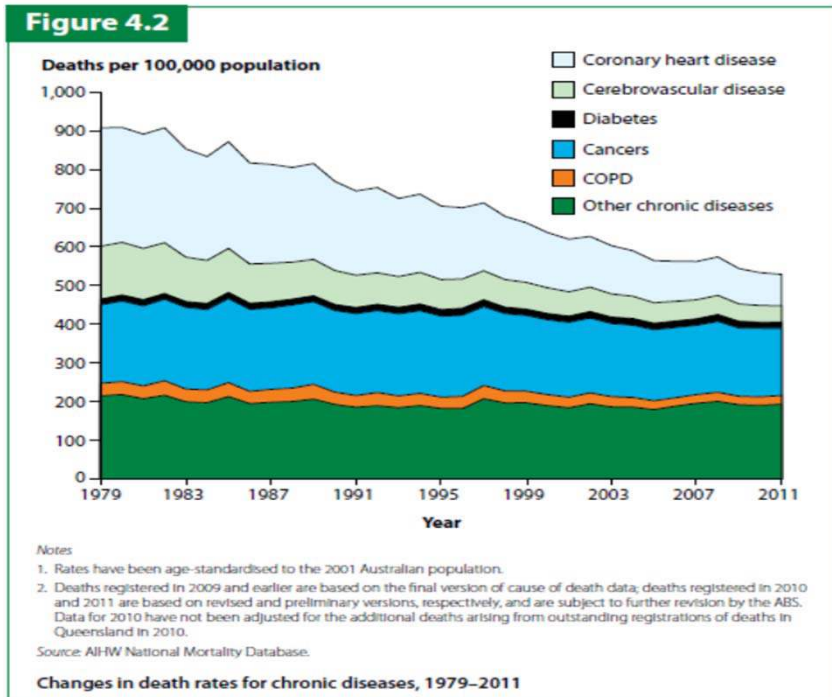
Where are Health \$'s Spent



Public Health = 2.2%

Research = 4.9%

Death Rates for Chronic Diseases



Leading causes of death:

- coronary heart disease (15%)
- stroke (8%)
- dementia (6%)
- lung cancer (6%)

Together, cancers are 2nd most prevalent cause of death

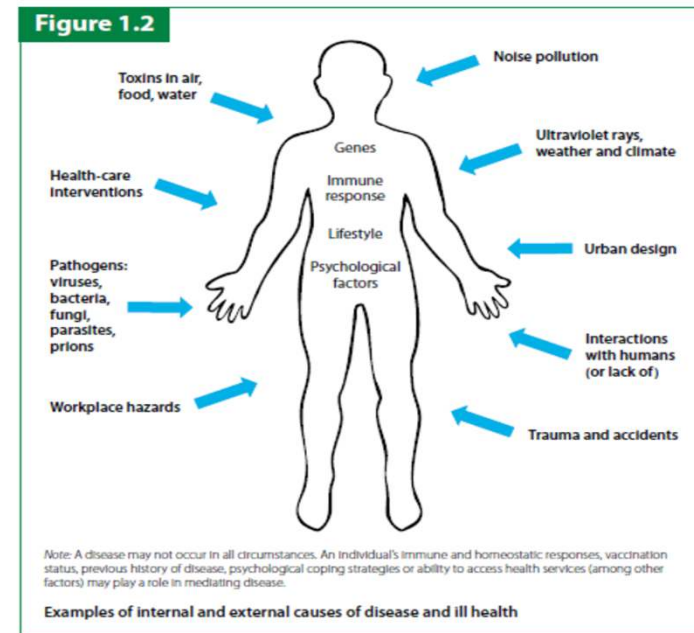
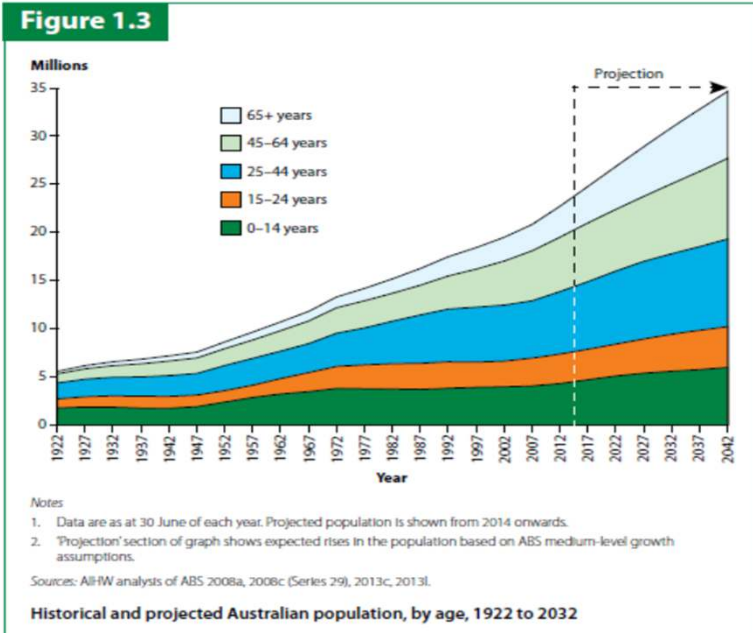
Overall, Australia has 2nd lowest mortality rate amongst all of the OECD countries (648/100,000)

Average Life Span has increased:

- baby boy (2010-12) = 79.9 years
- baby girl (2010-12) = 84.3 years

Source: Australian Institute of Health and Welfare 2015

Changing Health Paradigm



- People over 65 yrs = 9% in 1973, 14% in 2013
- Life-style related diseases, health conditions & disability have largely replaced infectious diseases as chronic disease concerns (e.g. tuberculosis)

Source: Australian Institute of Health and Welfare 2015

CRC Program – Medical CRCs (\$15-34m)



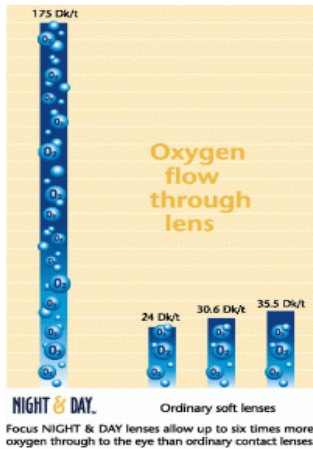
Medical CRCs - Participants

- 23 Australian + 24 international universities
- 40 Australian Institutes for Medical Research
- 29 medical technology companies + SMEs
- 12 major public hospitals, 37 health service agencies
- CSIRO
- Commonwealth DOHA, DHS, ATSIH & agencies
- State Government Health & other Departments
- Over 120 other clinical services agencies, professional associations and health-related foundations and networks

Medical CRCs – End-users & Outcomes

- **Public** – prevention of injury / disease
- **Patients** – improved / novel diagnostic, treatment or rehabilitative services
- **Physicians / health professionals** – knowledge & technology to improve services
- **Industry** – pharmaceutical /medical devices
- **Hospitals / health services** – enhanced delivery models for clinical healthcare practice
- **Government** – evidence-based research guiding policy
- **Researchers / Universities** – PhD opportunities (>300)

Outcomes & New Research



\$25 billion in sales over the intended life of patents



Night & Day Contact Lens



Accommodating Gel to replace hard lens in presbyopia
 ~ 48% of world's blindness



Models of Vision Care Program
 ~ 94% of vision loss in Aboriginal and Torres Strait Islander people could be prevented

CTx Business Outcomes (2007 - 2015)

Achievements

\$5.4m Wellcome Trust Seeding Drug Discovery Award

9 provisional patent applications

4 commercially licensed drug development candidates

3 published patents

2 commercially licensed Research Tools

~A\$230 million predicted impact over first 15 years of CTx,
a 1.6 : 1 cost benefit ratio



Advancing the prevention, diagnosis and treatment of oral disease

- World-first treatment for chronic periodontal disease in clinical testing with Sanofi Pasteur Ltd.
- Protective dental varnish launched in 2012 and now one of the largest selling varnishes in the USA.
- Chair-side diagnostic for major oral pathogen under commercial agreement with industry.
- Novel dental restorative material launched 2011.
- Recaldent™ tooth remineralising technology used in oral care and confectionary products sold world-wide.



Over \$A1 billion in global product sales

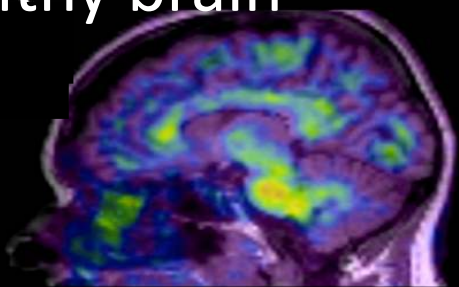
Research Outcomes

Transforming the lives of Australians with mental illnesses by early diagnosis and personalised treatment

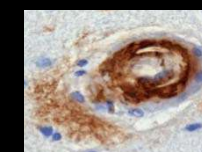
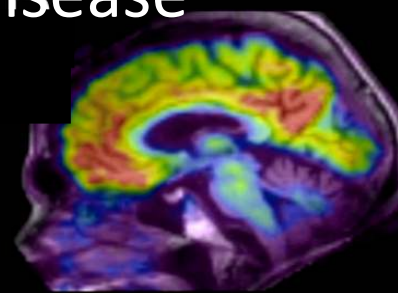


CRC for Mental Health

Healthy brain



Alzheimer's disease



- New method for identifying biomarkers of relevance to neurological conditions
- Several novel biomarkers identified that reliably predict whether a person has elevated levels of amyloid protein in brain (protein is linked to Alzheimer's)
- Panel of gene expression markers that can distinguish between schizophrenia and other related psychiatric disorders

Aims & Outcomes



promote increased Aboriginal and Torres Strait Islander control of the health research agenda and partnerships with key stakeholders to:

- ensure the effective transfer of research findings into policy and practice to improve primary healthcare, to build sustainable prevention and to reduce the disease burden on Australia's Aboriginal and Torres Strait Islander people
- build capacity in Aboriginal and Torres Strait Islander people to allow greater control of health research through increased formal education and training opportunities
- advocate for research-informed changes to the delivery of health services to Aboriginal and Torres Strait Islander people.
- Since 2011, the Lowitja Institute CRC and its predecessor CRC have offered a number of scholarships and professional support scholarships

Recognise Health

PROGRAMS

3 Research Programs: safe & supportive; connected & creative; user-driven & empowered.

Outcomes from e-Tools for Wellbeing project *(part of Program 1 - Safe & Supportive)*



Take Ray the Red Panda for a night out, monitor the fun and learn to identify and avoid your own “stupid line” for drinking.



Create a mood map of your music library, develop playlists to match music to mood, Create a music journey to enhance or change your mood.



The Mobile Application Rating Scale – assessing the quality of health mobile applications



Outputs

**Lost income =
\$A34,900/annum/child**

- The first Australian Autism Biobank established
- The Secret Agent Society social skills program commercialised ~ now subsidiary of Autism CRC with income of \$500,000 pa
- World-first Inclusive Research Practice Guides and Checklists for autism spectrum research launched
 - ~ National, standardized, accurate diagnostic tool to enable support at the right time
- Research Academy established to upskill researchers and adults on the spectrum to participate in co-production of research
- 16 PhDs, 5 Honours, and 9 post docs commenced

Interface: Manufacturing - Health



Focuses on improving the isolation, expansion and delivery of cells to target organs or tissues through:

- Development of novel materials and surfaces
- New scaffolds and carriers for cell growth and co-culture
- Components and tools for bioprinting

- Scaffolding for chronic wounds
- Transplant rejection
- Cardiovascular disease
- Type 1 and Type 2 diabetes



Outcomes into Utilisation



Australian National Health Priorities



Cancer Control



CRC for Cardiac Technology

Cardiovascular



Injury Prevention



Mental Health



Diabetes Mellitus



Asthma



CRC for Tissue Growth & Repair

Arthritis & Musculoskeletal



Obesity

Dementia

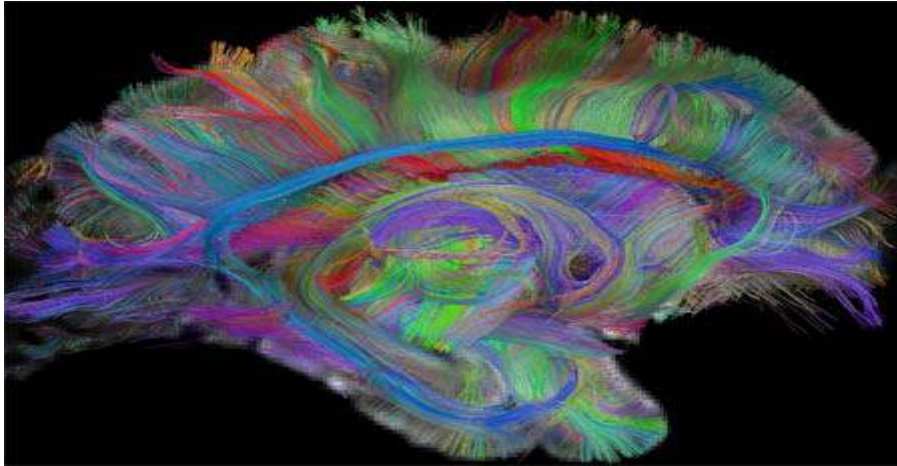


Future Trends / Drivers in Healthcare



What are the unexpected drivers for 'health' towards 2040?

New Knowledge remains Critical



- New brain imaging is uncovering linkages and functionality
- This leads to innovative diagnostic and treatment options

Drivers in Healthcare – “Global Health”

- “Billions needed now to tackle ‘superbug’ crisis”:
 - ~ Jim O’Neill (UK Gov’t Review of AMR) – estimates that AMR will kill 300m people prematurely in next 35 years (~2-3.5% less GDP)
 - ~\$A45.6bn needed globally over next 10 years to develop innovative antibiotics, little market incentive to do so
 - (The Australian – Friday 15th May 2015)

World Health Assembly addresses antimicrobial resistance, immunization gaps and malnutrition

New release

25 MAY 2015 / GENEVA - The World Health Assembly today agreed resolutions to tackle antimicrobial resistance; improve access to affordable vaccines and address over- and under-nutrition.



Hearing Disability: a global problem



- 5.3% of the world's population have a disabling hearing loss (the majority in developing countries)
- 80% of adults over 80 years of age have a hearing disorder that degrades communication and increases isolation, known factors contributing to cognitive decline

3 MARCH 2015 | GENEVA – Some 1.1 billion teenagers and young adults are at risk of hearing loss due to the unsafe use of personal audio devices, including smartphones, and exposure to damaging levels of sound at noisy entertainment venues such as nightclubs.



Drivers in Healthcare – “knowing the future?”

- Gene genie stuck in the bottle:
 - ~ 1998 – US Congress funds NIH to pursue analysis of human genome
 - ~ 1990 – first gene therapy trial for immunodeficiency disease
 - ~ 1999 – Human Genome Project completes DNA sequencing of chromosome 22
 - ~ 2003 – Human Genome Project completed
 - ~ 2012 – “Google Maps of the human genome
 - ~ 2014 - cost of sequencing individual’s human genome now \$A1,250

Entering era of personalised medicine through knowing your own individual genome: could enable right treatment for the right disease for the right group of patients delivered at the right time for the right cost

Drivers in Healthcare – “information access”

- Hyper-connected consumers and social media are changing and forcing change on the entire health ecosystem:
 - Mobile networks – 1.75bn smartphones globally, wearable technology and health-related apps
 - Social networks – Pfizer and others are using cure collaboration concepts on Twitter and Facebook to collate and share patient experiences
 - Cloud – massive data being collected from the above, and from new developments like FitBit – capturing your data
 - Big data – DATAtrack – 80% of all electronic data created in the last 2 years
 - Open access – J&J making all device/diagnostic data publicly available
 - EMA requires all clinical reports to be published

Focus on Connectivity & Ease of Use



“Made for iPhone” hearing aid accessories
Apple – US Patent application on February 7th
for a system to automatically detect a
hearing aid and incorporating switching
modes for its transmission



→ The dominant device for people with mild and moderate loss (the most numerous segment) will be a combined hearing aid and hands-free device based on their mobile phones, tablet devices, GPS, or other wi-fi enabled devices

Drivers in Healthcare – “www.doctor?”

- The internet gives us access to a vast “quantity” of information, but no real sieve to determine the ‘quality’ of what we find.

Is healthy drinking an oxymoron?



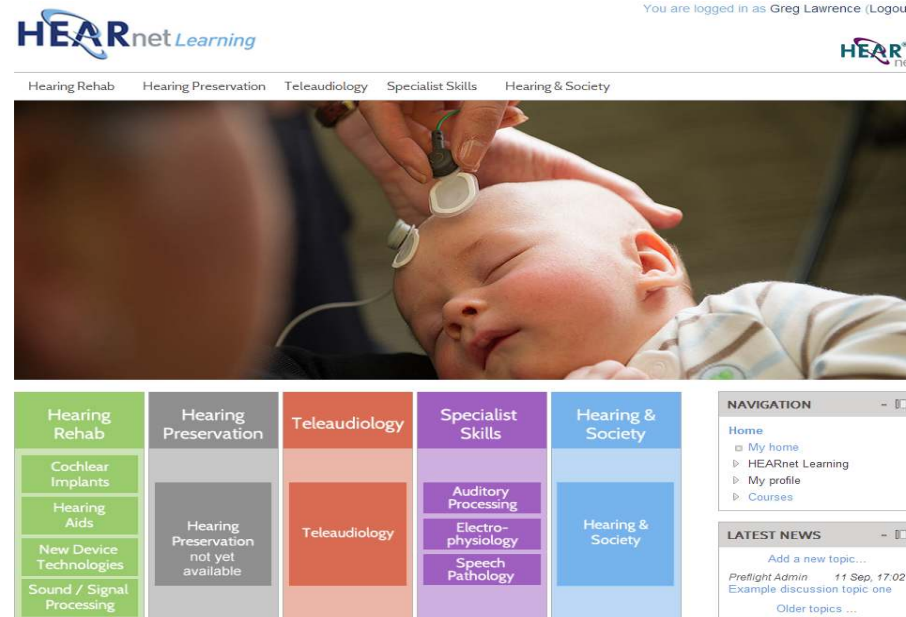
- (a) red-wine drinkers have lowest incidence of alcohol-related cancers (www.medicalnews.com today.com)
- (b) Beneficial associations between low intensity alcohol consumption and all cause morbidity may be attributable to inappropriate selection of referential group and weak correlational statistics (Knott et al, All cause mortality and the case for age specific alcohol consumption guidelines. BMJ 2015)

- Researchers need to concentrate on presenting the message to different audiences.

Drivers in Healthcare – translation portals



- HEARnet Learning
– web-based tool for public, professionals, researchers



- Health Tracks – web-based tool built by CRC for Spatial Information to merge health data with spatially-based datasets

- CRCs developing new tools for translating/communicating outcomes to use/impact

Drivers in Healthcare – new technology



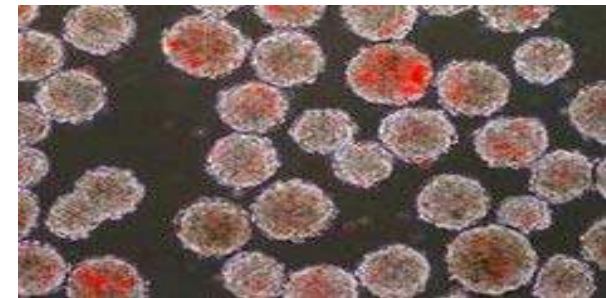
'robot human comprised of prosthetic systems/parts'
(Shadow Robot Co – UK)

- Prosthetic face
- Retinal prosthetic (Second Sight, USA)
- Cochlear implant (Cochlear, Aust)
- Robotic exoskeleton (REX Bionics – NZ)
- Robotic ankles/feet (BIOM – USA)
- Prosthetic hand (Touch Bionics)
- Artificial Organs
(heart, blood, windpipe, pancreas
spleen, kidney, circulatory system)
2/3 of human body

Drivers in Healthcare – new technology



- Replacement of parts of brain with chips (e.g. Hippocampus)



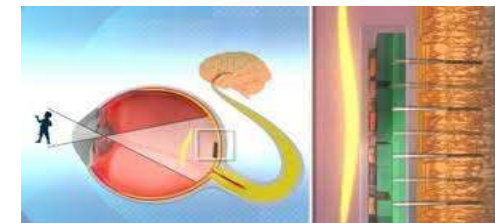
- Use of implanted artificial cells for drug delivery



- Full functional integration of prosthetics with body's normal neural system



- Mating of external prosthetics enabling restored functionality (e.g. exoskeleton)



- Replacement of damaged sensory organs with enhanced sensors

Drivers in Healthcare are – technology vs policy

Replacement or enhancement of organs or other body parts by mechanical versions (*differs from prosthetics by mimicking original function*)



“replacement to restore functionality”



“improvement to augment functionality”

- ***CRCs developing new tools will create ethical challenges for clinical application and public acceptance***

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