Home Health Monitor System

The Covid-19 crises has brought many new and novel ideas into the spotlight, and some of these will become important if the lockdown continues, or if conditions return or become intermittent over the next couple of years. While Australia seems likely to be among the first countries to revert to something approaching normality, national border bans will persist until problems are solved in some of the more remote and undeveloped parts of the world. We need to consider the consequences of this possibility.

The use of a standardised home health monitor has applications in both Australia and other parts of the developed world, it would also become a vital clinical tool for medical professionals in less-developed countries. Basic health-parameter monitoring systems also have applications well beyond the current virus problems, and they will appeal to those of us in first-world nations enough to generate a sizeable market. Devices costing a few hundred dollars or less have sales potential approaching the early mobile phones, and they can be manufactured with only a fraction of the phone's electronics. They can also using their optical and audio modules. It would probably sell at a much lower cost than a mobile phone since most of the development work has already been done.

Australia's biomedical and technical experts would be quite capable of creating a highly-standardised but extendible **Home Health Monitor System** which would become a front-line weapon in any continuing Covid-19 war and be widely used for decades after in other potential epidemics, and also provide some more normal on-line health monitoring services.

It could use existing mobile-phone and personal computer components, so most of the technical modules already exist. It would use Wi-Fi, Bluetooth and the standard NBN/internet data networking.

Even basic models would sell like hot-cakes at the present moment, and any framework design would allow for progressive upgrades.

While initially the emphasis is on the production of a useful monitoring device for Covid-16, the long-term aim must be to extend the system through these three phases:

1. **Phase 1:** A quick roll-out of a home device for family health monitoring. It would provide the user with simple alarms, and suggest when further tests are needed.
   - Via the internet and artificial intelligence systems, it would allow remote medical specialists/GPs to monitor a few of the more important indicators.
   - Over time it would create base-line records for everyone in the household, so that even minor changes can be quickly and easily detected. At this level the benefit is primarily to the household.
2. **Phase 2:** With greater household use and centralised on-line artificial intelligence analysis, the Home Health Monitor System would become a regional 'Sentinel network system' for early detection of outbreaks. At this phase level, the benefit is to the whole community.
3. **Phase 3:** Eventually the database and AI process would create a major research tool for identifying and analysing a whole range of health conditions. This phase has global benefits.

Monitor Applications

This suggestion has arisen as a consequence of the Covid-19 crisis which had made us realise our global vulnerability, the value of both remote medical consultations, and the potential importance of on-line automated services. This enthusiasm for medical monitoring is compounded by an increasing suspicion that the crisis may extend for many years (or be followed by another of similar intensity). Pandemic diseases of the Covid-19 kind can obviously have dire consequences ... especially for the independent elderly, living alone and without supervision. Such a device could be a life-saver for them.

The modern world, with its over-population, regional refugee problems, and nationalistic trade battles, now faces global transmissions of similar pandemic problems on an unprecedented scale, and the next attack (such as a mutation of SARS, Ebola, polio, measles, etc.) could well focus on children rather than the elderly.

Home unit: The main two physical components of the basic home unit are a battery-powered Body Monitor, and a nearby Charger/Relay unit. Software developments would also figure strongly: we are in the era of massive databases and artificial intelligence, and Covid-19 should warn us that Australia must develop a national pandemic sentinel system which is able to make full use of the artificial intelligence diagnostic techniques now available.

The **Body Monitor** would be a small electronic device which detects useful (diagnostic) body parameters, and utilises Bluetooth radio links to send the data to a nearby desktop charger unit which then relays it via Wi-Fi to a local computer. Alternately, it is pre-set to transfer the data through the internet to a remote autonomous AI analysis device. This can then redirect the output to medical practitioners, specialists, and/or just for storage in an individualised database.

I envisage the body monitor and relay units evolving through a number of phases. They would start with handling basic **temperature** and electronic **stethoscope** functions, and probably a **blood oxygenation reader** only. However both the relay and pod units would or could add additional features over time (some via up-grades, some requiring plug-in, some requiring model changes). Also the database software developments with AI accumulated data from many cases, would increasingly be able to provide analysis and diagnosis functions.

The aim eventually would be to have a national network based on these standardised small autonomous body monitoring devices which also detect and feed information to an evolving range of diagnostic services. The data could then be utilised either locally or via the internet:

- with information sent to a special application/database on the home PC.
- with the data communicated to a remote autonomous AI unit which can separate mixed data streams, process the signals, make judgements, and raise alarms.
- relay these information stream to a nominated medical practitioner or specialist during a remote consultation session.

Parameters

- **Temperature:** Since body temperature is held to be an early indicator of a serious virus infection, this was the first factor considered in this design. The standard method of measuring temperature with a mercury thermometer in the mouth is known to be pretty rough and variable. Also, we currently judge any findings of temperature variations against what we believe is an acceptable average for the population at large.

  Forehead Infra-red ('laser') Temperature readers regularly appear on our television screens in overseas news programs, but we don't see public authorities using them widely in Australia. Yet they are approved by the TGA and on-sale for $70-$150.

  > Various advertisements and reports suggest that the infra-red devices measure to within 0.1°C accuracy, and also say that 1.2°C rise in temperature is cause for concern. Other sources use both 36.0°C and 37.0°C as the reference normal, and suggest that a rise of 2.2°C diagnoses a fever. Yet one scientific report says that the normal forehead range found among 1000 subjects in a clinical measurement trial was between 31.0°C to 35.6°C, while Wikipedia says the normal temperature range on the forehead is between 35.4°C and 37.4°C, and treats 38.1°C as a low-grade fever and 39.4°C as high-grade. [All temperatures presumably taken within the home.]

  Until now we have not employed record systems to establish specific base-line temperatures for each individual or family member. Yet we know that the most useful indicator of an early infections is likely to be a small temperature variation from the individual's own "norm" -- whereas there is a wide range of variations in what is considered "normal" among community averages.

  Why doesn't Australia use Infrared Forehead Thermometers?
  My Google search hasn't turned up any trustworthy evidence that, IR forehead scanners used in public venues, are able to measure core body temperatures either consistently or accurately. They are designed for the clinical environment, and I doubt they have an outdoor accuracy better than ± 2°C. Yet we see them in use overseas in all weather conditions -- where they must be close to useless. My suspicion is that outdoor forehead device-readings would only reliably detect a high-grade infection (with the subject already comatose on a stretcher!).

  Such applications are probably only useful in the USA because they don't have Australia's better financial welfare system and free high-quality medical care. Undocumented migrants and others in America are often forced to circumvent the lock-down demands to survive, and forehead detectors might therefore be used to scare them into staying at home.

  Accuracy or Consistency?

  We shouldn't confuse the need for temperature-reading **accuracy** with the concept of **consistency** during a pandemic crisis. It is the change in an individual's temperature when measured in the home which may still provide us with highly viable evidence of infection. The device must provide consistent daily temperatures measurements which can be compared with a regularly-maintained base-line for each individual.

  Small changes in temperature could well be the easiest mass-detection method for indications of early infection. This would be important because it would allow possibly infected people to self-isolate from other family members. So the theoretical accuracy of the device is of secondary importance to its consistency; and consistency requires the same device be used regularly in the same environment.

  So what is the best temperature-measuring system?

  Inserting a thermopile into the blood-stream is generally taken to be the only really accurate way to measure core body temperature. However, four orifices are commonly used for diagnostic and monitoring purposes: mouth, ear, vagina and anus. Underarm monitors are also widely used in Intensive Care Units, where patients are often unconscious.

  The first four of these techniques have physical and sterility problems which diminishes the likelihood that temperature will be taken daily in the home with each family member (ideally on wakening, while still inactive in bed). Yet this is probably essential to establish individual base-lines.

  It seems to me that the most consistent and reliable point for detecting finer gradations of an individual's core temperature would be to measure under the armpit where it would not be influenced by direct air contact or by drinking or eating.

  The source of confusion: A widely quoted *Annuals of Internal Medicine* report from 2015 says "*Rectal temps are the most accurate. Forehead temps are the next most accurate. Oral and ear temps are also accurate if done properly. Temps done in the armpit are the least accurate.*" It says that the peripheral thermometers (armpit and ears) were especially inaccurate in patients with very high fevers. With extremes, external thermometers could read "*as much as one to two degrees higher or lower than actual body temperature.*"

  I think the statement above is misleading in the context of home monitoring, when the home owner is trying to determine if any in the family has come under threat from outside contact.

  The authors of this report were clinically-focussed and were emphasising the accuracy of devices used in a clinical setting ... comparing their measurements against a thermopile inserted into a blood vessel.

  Approved Devices: There are two device-approvals classes quoted in the literature, "ISO 9001" and "TGA Class IIa No.333214", neither of which helps much because they are mainly concerned with safety. Confusion about which body temperature device to use as the primary indicator of infection results from a lack of distinction between applications:
  - **Intermittent measurements:** The use of these devices for general public temperature measuring. The requirement is for a temperature reading which gives the medical specialist some indication of the need for further investigation (or for rapid action). Note that hospitals happily use armpit measurements in ICUs. Since average core temperatures vary so much, occasional clinical measurements can only indicate the need for further investigation.
  - **Long-term monitoring** These devices are intended to be used to monitor changes in a single individual's temperature over a period of time. For home or hospice use therefore the emphasis should be on consistency. A minor temperature change may then be an adverse indicator (as distinct from than the actual temperature measurement).

  Among the general population, probably and accuracy of 2.0°C is sufficient. But for individual monitoring, a consistency within ± 0.1°C range would be ideal.

  Overall, the vagueness of public temperature measurements taken with forehead or other measuring devices, suggests that they are generally very poor primary indicators of a viral infection unless the patient already has other significant symptoms, and is probably already suffering some distress.

- **Advantages of Underarm:** There are many advantages in the under-arm approach to reading daily temperatures in a family. This is extended for general health and other parameter monitoring over the long-term (as distinct from any clinical applications):
  - An under-armpit device would not be fragile (as is mercury in glass) or need special handling or a high standard of sterilisation.
  - Such a pod can be slipped under the armpit of a sleeping child or adult.
  - Because it is totally surrounded by dense body tissues, it should be highly consistent in its measurements. But whether it is accurate enough, is obviously debatable -- provided we known what is meant by "accurate", and know "which community standard?".
  - The pod can be left in place for long periods of time This is obviously especially important for comatose patients. And for young children it could be held in place in a special pyjama pocket.
  - **Overall, the pod and relay approach can become the foundations of an evolutionary system, incorporating AI-enhancement of a range of health indicators.**
  - **Over time, this could eventually extend into a national public health monitoring system.**

  A key factor must be that that the physical design of both pod and cradle allow them to incorporate other detectors developed at a later date. Also, since home use is envisaged, mass production costs must be kept low initially by using existing micro-electronics components.

  These are my suggested physical parameters:

  

  - The device needs to be lenticular, probably 30-45mm diametre for a child, and 50-60mm for an adult; about 9-12mm thick at the centre.
  - It would have low-power Bluetooth links to a nearby Wi-Fi unit, which is both the resting pod's cradle and relay station.
  - The pod battery would be charging (by induction) when the not in use.
  - The pod would switch on and begin transmitting when removed from the charging station.
  - The pod would be moulded plastic and completely sealed, with no sockets or entry ports so as to be easily cleaned and sterilised.
  - The relay unit would need to provide some simple way of code-identifying the data so it is recorded as coming from a specific person. (keypad and display)

  Most importantly, there is already a range of useful bio-detection systems that could be incorporated into such a pod and more that could be plugged directly into the relay unit. This range of ancillary devices would certainly be extended in later models. Battery power in the pod is probably not a problem, because it generally only needs leave the charging station for relatively short periods of time. Bluetooth has very low power demand (ideal limit, perhaps 12 hours).

- **Stethoscope:** Next to temperature, the easiest and most useful secondary devices which could be easily incorporated into such a pod is the transmission of body sounds. This is obviously especially true of Covid-19 which attacks the lungs, the heart and to a lesser extent, the brain. Under-arm is probably the best possible location for stethocope sounds since it is enclosed; and immediately adjacent to both the lungs and the heart. The micro-components needed to create and handle these frequencies are already available in today's mobile phones.

  Also, frequency separation and AI would eventually overcome a notorious problem: The variability of stethoscopic diagnostic ability by specialists, GPs, nurses, and midwives. It is obvious that the average hospital or clinical practitioner must be missing at least half the most important information being conveyed through the stethoscope, and some of older practitioners (often the specialists) will be missing more. There are a range of problems:

  - an extensive range of individual skills: some have hearing impairments;
  - they often operate in noisy conditions and under time-pressures,
  - they are dealing with complex blends of sounds ... breathing and lung + heart and blood flow.
  - pregnancy, gastric noises and obesity add further complications.

  In the early stages of a Covid-19 infection, when deteriorating functions are only just beginning to manifest themselves, modern electronics, audio enhancement and artificial intelligence should be able to make an order of magnitude improvement to stethoscopy.

  The micro-electronic component needed to add stethoscopic functions to an under-arm pod already exist in mobile phones. They are relatively cheap, and the digitised audio system of a cellphone is superb at the source. Even if the transmission line/signal quality is poor, the digitised audio can be stored and forwarded later, or it can be sent at a slower pace, or replayed repeatedly to fill any signal drop-outs. This type of digital automatic re-transmission (with auto-correction) is child's play these days when signals are handled via standardised mass-market products.
  [Note also that such signals can still be conveyed by analogue radio and the older analogue phone systems of the outback and the third-world, as well as over the digitised NBN.]

  Ideally the same standardised audio device could be available for pods in the home, hospital, the doctor's surgery, the nursing home, cruise-ships, or even for use remotely over internet links to third-world villages and those generally outside the range of conventional care. This would allow an artificial intelligence computer located anywhere to differentiate and isolate the source-streams of the body's blend of audible signals and feed clear signal streams to the recorder or practitioner.

  When personal identification codes are attached to the records, medical researchers and artificial intelligence systems should be able to monitor even subtle changes in the stethoscope's accumulation of evidence over time, and this would revolutionise the use of stethoscopes. Individualised clear-stream stethoscopy could well become a vital early detection tool for Covid-19 and eventually for a range of progressive conditions.

- **Skin colour detector:** Since the armpit is not exposed to the sun and weather, then it is likely to be an ideal location to take readings of skin colour, which can provide good indications of oxygenation levels. Currently a detector is clipped onto the finger and the device detects changes due to absorption as the light travels through the flesh. Oxygenation is measured at the blue end of the spectrum.

  A very similar device could also detect potential hormone-induced changes in melanin levels and other skin colour changes at the yellow-red end. With relatively standard LEDs and a couple of optical detectors (perhaps one on each side of the pod?) it would be a sensible parameter to consider.

  A surface detector is needed to be recording the skin's surface colour, while the oxygenation detector needs to have the light-source hard against the skin and detector recording light reflecting back from blood vessels a few millimetres below skin level.

  A possible minor complication might arise from the use of underarm powders and deodorants.

Artificial Intelligence:

We are now at the stage where AI applications can be productive in PCs, and even better in larger centralised installations with mass inputs of standardised data. AI can be applied usefully, both to interpretative functions, and also to unravelling complex signals into their component parts: either ...
1) locally within a PC.
2) by a remote autonomic computer attached to either a database or a voice-feedback system.
3) as an audio-stream/differentiating aid, with output being fed back to a GP or specialist.

Probably the most value which will be derived from the AI treatment of stethoscopic sounds will be the computer's learned ability to separate complex information streams and process them independently. There are four main contributors to the stethoscope audio where AI could be revolutionary:
- the heart-beat and its arterial blood-flow and valve functions;
- lung congestion and inhalation/expiration efforts (cough reflex);
- some gastric sounds
- uterine sounds if pregnant.

In the early stages, I would guess that stream separation would probably be the major value of AI, with actual diagnosis still reliant on the expert's medical ear. However even basic AI would certainly able to raise alarms (fibrillation, heart irregularities. etc.) With wide-spread use and good record-keeping and feedback, we could expect AI systems could quickly learn to distinguish early traces of potential problems of many kinds, and possibly even provide a preliminary diagnosis.

China is using AI facial recognition to identify individuals in protest groups, and this sort of comparison involves many more parameters and has many less refined measurements than stethoscopic sound identification. So this will not be a problem in a few years.

Base/relay/charging unit:

These bed-side units would be fairly conventional in electronics.

1. They would detect the presence of a pod in their cradle and charge the battery by induction (to avoid having sockets in the pod).
2. When the pod was lifted from the cradle, they would signal the pod to switch on.
3. they would hold the key-board selected ID stream-code for each individual user, and initiate interconnection procedures via WiFi to a local PC, or further through the internet to a remote device or database.
4. They would translate data from the pod into digital internet protocols.
5. They would also provide sockets for direct input from auxillary devices, such as opthalmascopes, etc.

Initially these units would probably be fairly dumb -- about as complex as a modem -- but later they may benefit from intelligence and some autonomous applications. They would initially need a small numeric keyboard, a tiny dot-matrix screen, and probably a standard PC cable point. Later models will have more intelligence and probably be programmed through a PC.

Identification of the data-stream will be important since pods will probably be used by many family members. ID codes are essential to construct individual base-lines for each family member, so an ID must be easily selectable at the bedside without needing a PC.

Potential for Later Elaboration

Auxilliary devices

Once the basic system and database services are established, clearly many more devices could become incorporated into later versions of either the pod or base-unit.

Possibilities include:

- **Tremble detector:** It has been suggested that a pod could easily incorporate a tremble-detector, and that this may also provide another useful diagnostic parameter. It is worth consideration because it is simple, but we don't know whether it would provide general-purpose diagnostic value. It would be helpful for restlessness in children also.

- **Insulin indicator:** Finger-prick insulation test devices are already widely used by diabetics. These are already well established and satisfactory, so, while it would be possible to incorporate one of these as a plug-in device to the base-unit. The only advantage would incorporating insulin levels in the individual's database as a long-term progressive record.

- **Sweat composition:** One of the often mentioned symptoms of Covid-19 is excessive sweating, so skin conductivity might be worth measuring - probably initially by way of a low-voltage link between skin contacts on each side of the pod, but later perhaps by an embedded chip in the pod, along the lines of the detector used by diabetics with their finger-prick insulation checking devices.

  Excessive sweating during illness is probably an evolved elimination device, so there is likely to be a range of proteins in the sweat which are indicators of both the cause of the illness and its progression.

  We know from the widespread use of the single-cell electrophoresis "comet assay" tests that damaged DNA strand fragments are semi-conductors which, under the influence of an electric field, will develop electrical polarised attractive forces which provide an indicator of the fractured DNA strand size. So this is obviously an avenue worth exploring further. It could well lead to useful new diagnostic parameters.

  In summary, the electrical resistance of the skin might well just be a first step to a more comprehensive 'home laboratory' test device.

- **Blood-pressure:** This is obviously of doubtful inclusion in the early pods, but the armpit is at the physical junction of the body where the pressure pipes of the arm and heart meet, so it is worth further investigation. I suspect that no one has really investigated the possibility.

  Wikipedia says about the arm-pit location: "*Pulsation of the artery can be felt by deep palpation of the axilla after abducting the arm.*" The area is fed by the axilla artery which is close below the skin and is a sub-branch of the brachial artery. The split is close to where the arterial pressure of the brachial artery is measured with conventional arm-cuff devices ... although increasingly BP is also measuring at the wrist.

  One comparison of conventional user-owned BP monitors by *Choice* suggested that "*the best is only 90% accurate*". [Again, the question of accuracy V consistency?] It is not the absolute pressure that is important rather than possible changes in systolic pressure over time.

  Supposedly BP should be measured at the level of the heart; clearly the wrist and lower arm models would introduce discrepancies. I wouldn't write BP detectors off as a future component in an armpit pod, but clearly it needs development, and is not a high priority. At best it would need new forms of pressure-detector which avoids the need for the cuff inflation to block arterial flow.

  Blood pressure changes would obviously be an important parameter as a part of the overall record handled by any artificial intelligence system, but in the absence of a way of measuring it in the pod, a conventional inflatable cuff BP device could be added as a plug-in unit.

- **Ophthalmoscope:** The ageing of the population means that four different eye conditions are increasingly deserving on-going observation and measurement:
  - cataracts are usually slow in progression, and nothing much will be gained by regular home monitoring,
  - floaters - these can sometimes indicate blood vessel fragility and early signs of serious eye problems (retinal tears), but generally the main value would be in putting to rest unwarranted fears of the elderly.
  - macular degeneration has two forms, but neither would gain much by regular monitoring -- however an automated system might pick up early stages of degeneration leading to earlier medical intervention.
  - **glaucoma, a major cause of blindness,** needs regular monitoring ... and this would be vastly improved by home detection for intervention plans.

  The ophthalmoscope is potentially a device which could be vastly enhanced by electronics. Without drugs to dilate the pupil, many medical workers have difficulty in seeing inside of the eye other than the central area of the retina. Optical capture and computerised 'tileing techniques' can be used these days to post-construct a high-quality 180° image.

  Primary open-angle glaucoma. Optometrists and Ophthalmologists consider this to be the serious eye condition that would benefit most from regular monitoring, both to aid early detection of the condition, and to maintain a treatment regime. It is a major cause of blindness.

  Primary detection of glaucoma is usually made by a specialist observing the head of the optic nerve using an Ophthalmoscope. If the eye has abnormally high intraocular pressure (IOP) then the entry-point of the optic nerve is depressed, and it is then obvious that blood vessels within the nerve sheaf are being distorted.

  This will inevitably lead to the need for regular readings of the eye pressure (monitoring drug dose), and usually a life-long need for monitoring and treatment (including surgical intervention in most cases). This is one area where Artifical Intelligence systems would help both with public mass-screening, and ongoing monitoring.

- **Tonometry:** The most accurate method for measuring the IOP of the eye uses a tonometer which makes physical contact with the cornea (applanation) to test the force needed to distort it. This therefore requires eye-drops to numb the corneal surface, and so it is a clinical procedure.

  However, for mass screening, air-puff tonometry has proved useful enough, and this could probably be developed in a small hand-held user device for glaucoma sufferers. The problem is that the 'normal' eye pressure range is about 16 mmHg (mms of mercury) with a very substantial [±8 mmHg] variation. For older people this may be about 20 mmHg, and on top of this, each individual may have an acceptable daily variation of 2-6 mmHg around the average. Physical activity can cause significant variations.

  These daily measurement would be invaluable for monitoring the treatment of glaucoma sufferers. So the regular use of a simple air-puff device, where the readings are compared to the records of a long-term database, could be a very valuable monitoring tool for the prevention of progressive blindness. The tonometry function could probably be incorporated into a hand-held ophthalmoscope plugged into the base unit.

  Non-contact air-puff tonometry. These devices measure the angle of deflection of a laser beam, resulting from the flattening of the cornea, when it is subject to sudden pressure from a puff of air. Glaucoma is a general name applied to conditions of raised intra-occular pressure which can damage the optical nerves, so raised IOP above the individual's normal this is relatively good indicator that medical intervention is needed.

  For a while optometrists were advised not to use the air-puff technique because of the possibility of spraying virus with the tears, so, for a brief while it was considered to be a low-level Covid-19 risk to the operator in a clinical setting.

  However, it has enormous potentially for regular home monitoring by an individual. Already, wealthy glaucoma sufferers now purchase their own air-puff tonometers so as to monitor their intraocular pressure daily. It wouldn't take much to miniturise the device to the point where it could be mass produced and incorporated into this HHM system.

- **Floaters:** The eye is filled with a jelly-like substance (vitreous) which progressively becomes more liquid with age. Older people can normally see some fine shadows of 'floaters': threads or filaments within the vitreous, and these often drift slowly when looking at a blank wall or surface. When you try to look at them, they move quickly away.

  An ophthalmoscope can focus on the more substantial of these floaters, but they are generally only of serious concern if they appear suddenly, or if they cast clear-edged dark shadows, which is evidence of blood-clot traces close to the retina. This may signal a serious retinal condition.

  It should be easy for artificial intelligence systems to identify the problem type.

- **Microscope:** Obviously any optical device like the electronic opthalmoscope is equally capable of becoming a microscope, just with minor optical additions. This is unlikely to have much home use, but it may provide long-distance clinical laboratory support services, especially for remote communities.

The System

When you introduce daily-use bio-medical detection tools into a family setting, and then progressively feed data to individual databases, then you are creating something completely new in medicine. In normal times, they may not be widely used; but in times like this (and for many years in the future) I suspect that they would take off and become a 'must-have' device in most families.

For long-term use the design framework needs to be reasonably open-ended:

- Initially they can provide an additional diagnostic service for the individual and the family. This will supplement the services of the family GP.
- Over time they will create long-term track records for each individual and the family as a whole. These records would carry evidence of any slow, progressive deterioration, or common problems with the environment. (lead poisoning, etc.) With AI, this may well become an early-alarm system for a range of potential health problems outside Covid-19.
- Provided database privacy can be assured, the system could eventually become a societal sentinel tool for local health authorities to find and track the progression of all kinds of epidemic conditions -- from influenza, through toxic problems, up to Ebola, Covid-19 and beyond.
- Provided there is standardisation of the data held in the national anonymised database system, this resource would also become a revolutionary new research tool for public-service studies in epidemiology, toxicology, and the tracing of biological mutations.

Stewart A. Fist

70 Middle Harbour Road
LINDFIELD 2070 NSW
Ph:(02) 9416 7458
Email: stewart_fist@optusnet.com.au