Submission No. 93
(Inq into Obesity)
Rec 18/6/08

TeleMedCare Pty Ltd
ABN 65 050 042 192
Unit 7, 6-8 Crewe Place
Rosebery
NSW 2018 Australia
Phone +61 (0)2 9313 8136
Fax +61 (0)2 9313 8564
www.telemedcare.com.au

13th June 2008

Standing Committee Inquiry into Obesity in Australia
Standing Committee on Health and Ageing,
House of Representatives, Federal Parliament

Dear Sir/Madam,

I note that "The Committee will inquire into and report on the increasing prevalence of obesity in the Australia population, focusing on future implications for Australia' health system. The Committee will recommend what governments, industry, individuals and the broader community can do to prevent and manage the obesity epidemic in children, youth and adults".

I would like to present a submission to the Standing Committee in my capacity both as CEO of TeleMedCare and as a Professor of Biomedical Engineering at the University of NSW. TeleMedCare Pty Ltd is a startup company, established to commercialise telehealth research undertaken at the Biomedical Systems Laboratory at the University of NSW.

TeleMedCare is recognized internationally for its innovation and excellence in telehealth and has won numerous awards, including the BioFirst Commercialisation Award from the Government of NSW in 2007, and in 2008 a BioFirst Proof of Concept Grant of $100,000 for the "*PreventaFall + A Personal Alarm Response System for Falls Monitoring and Prevention*". However of particular relevance to this committee was the awarding in July 2006 of a Commercial Ready Grant from ASusIndustry of $249,883 to develop a "*Wearable Energy Monitor for the Management of Obesity and Diabetes*".

The Commercial Ready application is attached and makes reference to research on the increasing prevalence and incidence of overweight, obesity and diabetes throughout the developed world. This project is now complete and I would like to take the opportunity of presenting to the committee and alternative view that proposes the use of personal monitoring technology, health education and access to personalized health information and the setting of personal targets as potentially making a significant contribution to the management of obesity in Australia in a very practical and concrete way.

We note as a brief note on overweight, obesity and diabetes, an article publishedin the SMH on the 21st Ocyober 2006, titled "Obesity's huge cost dwarfs Medicare". The article quotes the following statistics from Access Economics.

Obesity cost Australians $21 billion in 2005. These costs include;

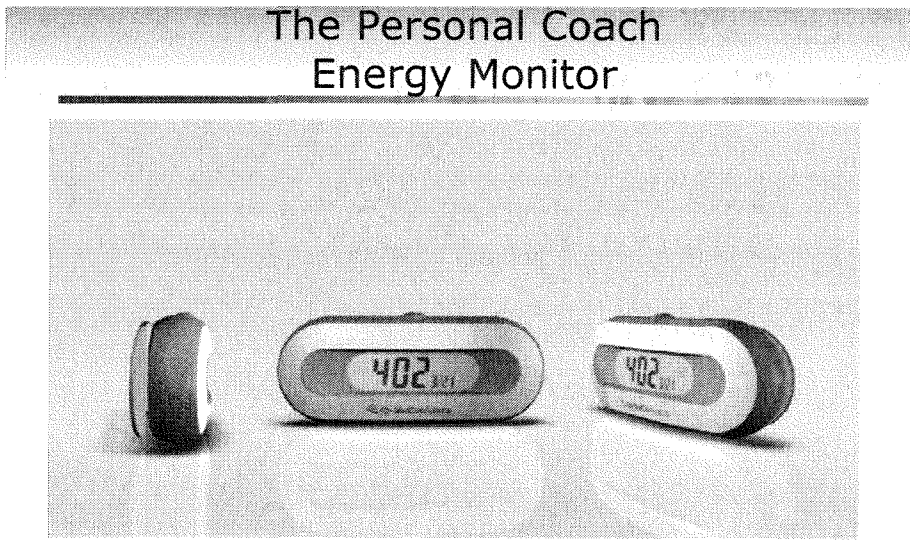
- Low wellbeing, disability and death: $17.2 billion
- Productivity Losses: $1.7 billion
- Health system costs: $873 million
- Carer costs: $804 million
- Tax lost and welfare costs: $358 million

Our research was thus motivated by the question, *"How can assistive technology help motivate both the young and the old to better manage overweight and obesity?"*

The results of our R&D are a range of wearable products for lifestyle management. Three products were developed addressing different needs;

- **The Personal Coach**
  - Personal health and fitness management
  - Management of overweight and obesity
- **The Professional Coach**
  - Professional health and fitness management
  - Supported by Personal Health Education Portal
- **The Diabetes Manager**
  - Clinical management of diabetes
  - Supported by specialised web services for management of diet, exercise and Insulin use.

The technology developed is based around an energy monitor able to monitor external energy expenditure with an accuracy comparable to that of gas analysis. This monitor is shown in diagrammatic form below;



Many years before I returned to University, I was Director of Research at the Medicheck Referral Centre and in 1980 I established one of the first Executive Health Programs in Australia. The program used an exhaustive set of questionnaires, lifestyle assessments and medical tests to assess the individual's personal risk of developing either an acute or a chronic disease. Once these risks were identified a comprehensive program of counseling, lifestyle management and psychological support was put in place to reduce or eliminate the perceived risk. At that time we found that the most powerful motivator for changing lifestyle risks was quantitative, numerical evidence on the patient's health status and clear evidence that progress was being steadily achieved.

We believe that a similar conclusion may be reached for the management of overweight and obesity. In the face of intractable difficulties often encountered in managing ones' diet and maintaining an exercise regime, a powerful motivator is objective feedback on ones' energy expenditure in the context of personal targets that are changed gradually and almost imperceptibly to promote a slow but steady improvement in health and fitness.

TeleMedCare now has the technology and the health informatics infrastructure to test this hypothesis and has proposed together with its colleagues at the Biomedical Systems Laboratory, a unique experiment targeting year 10 school children to demonstrate or negate the effectiveness of such an approach. A detailed experimental protocol for a Randomised Control Trial is attached as a template for the sort of practical research and evaluation that we believe is absolutely essential if this problem is to be tackled effectively and at low cost.

We would be pleased to collaborate with other Schools of Public Health and experts in the area of motivational psychology to further improve the probability of success of such an intervention. We also note that young people in particular are extremely early adopters of personal technology such as iPods and other devices, and we are confident that with the appropriate marketing of the concept of a technology based personal trainer for the management of health and fitness, together with personalized health education and other motivational tools, such an approach has a good chance of successfully modifying risk factors associated with overweight and obesity.

We would be pleased to discuss this proposal in greater detail with the Standing Committee if it feels that such an approach has merit and should be explored further.

Yours Sincerely

Professor Branko Celler
CEO, TeleMedCare Pty Ltd
and,
Director, Human Performance Laboratory and Laboratory for Health Telematics
University of NSW

Contact Details:

TeleMedCare Pty Ltd
Unit 7, 6-8 Crewe Place,
Rosebery, 2018, NSW

Tel: 02 9313 8136
Fax: 02 9313 8564
e-mail: branko.celler@telemedcare.com.au

The Personal Coach: wearable energy monitor for the management of overweight and obesity : A Project Proposal

Prof. Branko Celler
CEO

TeleMedCare Pty Ltd

branko.celler@telemedcare.com.au

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Monitoring Human Movements With Accelerometers

Accelerometers have been used to:

- Estimate metabolic energy expenditure, a measure of physical activity (Bouten 1997, Chen 1997, Fehling 1999, Steele 2000)
- Classify postures and activities such as sitting, standing, lying, walking, stair climbing and cycling (Foerster 2000, Uiterwaal 1998, Fahrenberg 1997, Veltink 1995)
- Assess balance and postural sway (Kamen 1998, Mayagoita 2002)
- Study gait patterns (Sekine 2000, Aminian 1999, Evans 1991)
- Study sit-to-stand transfers (Troy 1999)
- Detect falls (Petelenz 2002, Lehrman 2002)

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TeleMedCare Pty Ltd
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Rosebery, 2018, NSW, Australia
www.telemedcare.com.au

TeleMedCare Ltd
United House,
Carlton Boulevard, Lincoln, LN2 4WJ
www.telemedcare.co.uk

Basic Principles

- Triaxial Accelerometer
  - Estimate energy expenditure of daily activity

$$IMA_{tot} = \int_{t=t_0}^{t_0+T} |a_1| dt + \int_{t=t_0}^{t_0+T} |a_2| dt + \int_{t=t_0}^{t_0+T} |a_3| dt$$

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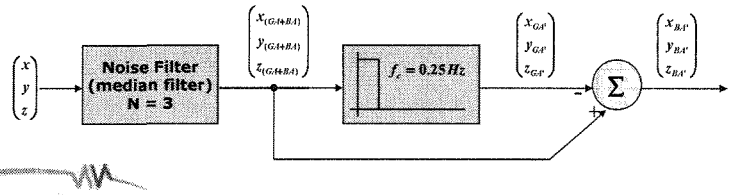
Triaxial Accelerometer Signals

- Linear sum of five components
  - Acceleration due to body movement (<20Hz)
  - Acceleration due to gravity (< a few Hz)
  - Accelerations caused by external vibrations
  - Artifact
  - Noise intrinsic to the accelerometers



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Monitoring Human Movements

Traditional methods:

- Objective assessment with dedicated sophisticated laboratory equipment
- Subjective assessment based on clinician observation and patient recall

Accelerometers offer an objective, low-cost, and portable alternative.

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Overweight, obesity and diabetes

- "Obesity's huge cost dwarfs Medicare" SMH 21/10/06
  - Obesity cost Australians $21 billion in 2005
  - Low wellbeing, disability and death: $17.2 billion
  - Productivity Losses: $1.7 billion
  - Health system costs: $873 million
  - Carer costs: $804 million
  - Tax lost and welfare costs: $358 million

  (Access Economics)
- How can assistive technology help motivate both the young and the old to better manage overweight and obesity?

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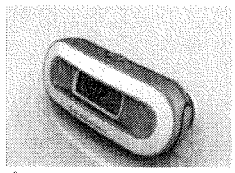
Wearable products for lifestyle management

- Three products addressing different needs;
  - Personal Coach
    - Personal health and fitness management
    - Management of overweight and obesity
  - Professional Coach
    - Professional health and fitness management
    - Supported by Personal Health Education Portal
  - Diabetes Manager
    - Clinical management of diabetes
    - Supported by specialised web services for management of diet, exercise and Insulin use.



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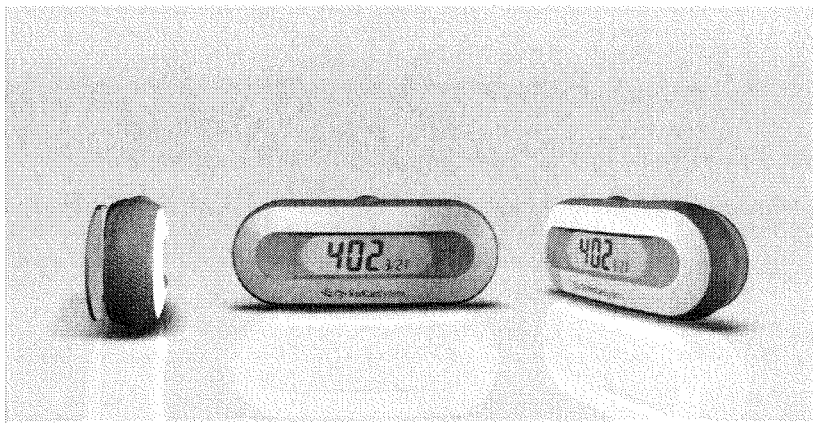
The Personal Coach Energy Monitor



- Ergonomically designed – easy to use!
- Feature rich - Multiple modes of operation
- Monitors energy use continuously
- Much more accurate than pedometers

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Mode of operation

- Records energy use continuously over 10sec intervals
- Data is stored continuously in memory
- Can be used as an energy stop watch
- Data can be downloaded to a PC to provide a day by day measure of energy consumption
- Quantitative longitudinal data is compared against personal targets
- Personal targets are incrementally increased to motivate attainment of personal best

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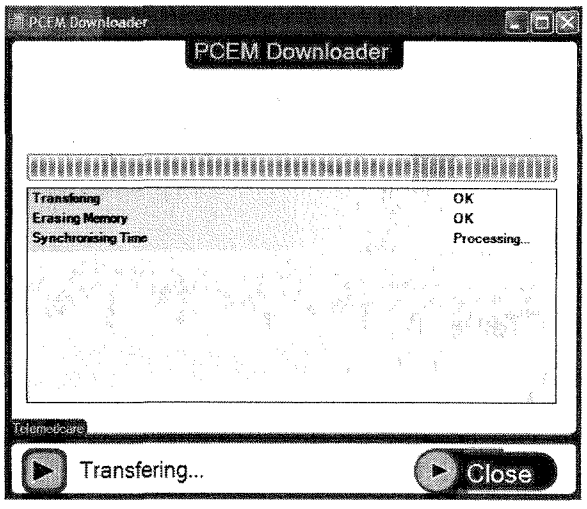
The PC Downloader



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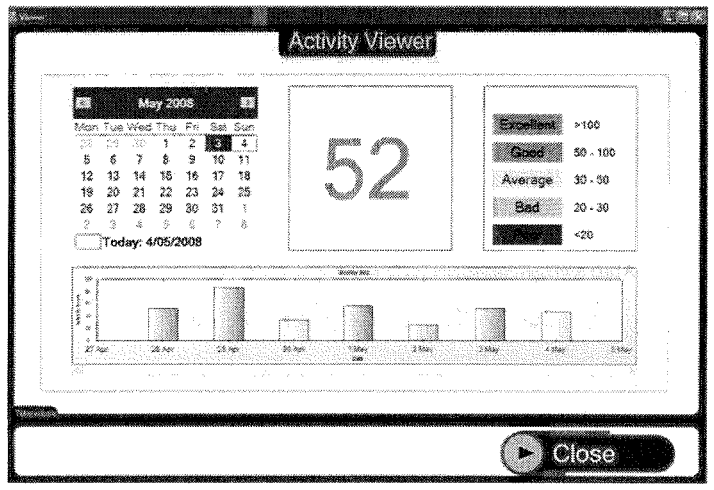
The Activity Viewer for Personal Use



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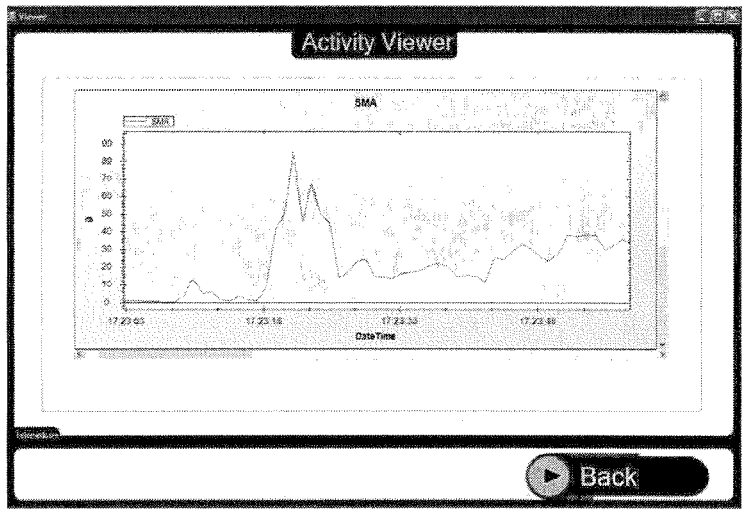
Graphical Viewer for the Personal User



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Unit 7, 6-8 Crewe Place
Rosebery, 2018, NSW, Australia
www.telemedcare.com.au

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United House,
Carlton Boulevard, Lincoln, LN2 4WJ
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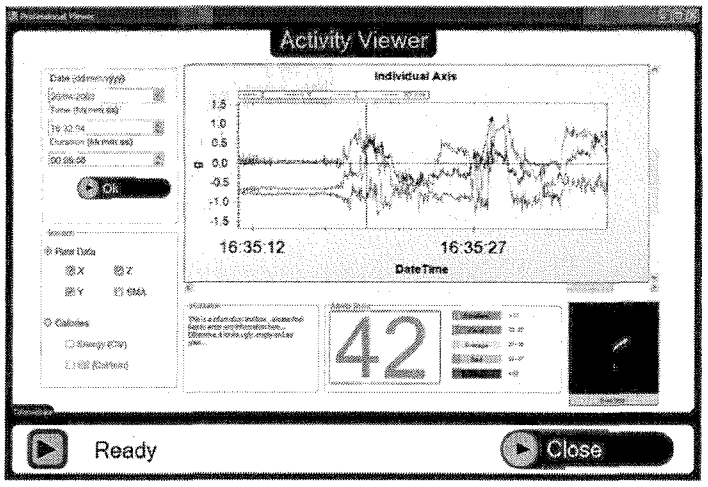
The Activity Viewer for the Professional (Research)



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Application of the Personal Coach for Diabetes Management

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Rosebery, 2018, NSW, Australia
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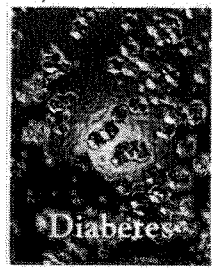
TeleMedCare Ltd
United House,
Carlton Boulevard, Lincoln, LN2 4WJ
www.telemedcare.co.uk

Background

- Diabetes → major chronic disease in Australia
- Type I Diabetes →by insulin injection.
- Type II Diabetes → by tablets, insulin, diet, exercise
- Diabetics rarely adjust insulin dose accordingly.
- Technology may help diabetics in controlling blood glucose (BGL).
  - Guideline to adjust insulin dose published by Diabetes Australia. However, no one has implemented it.
  - No available BGL models are globally acceptable.



"How to adjust insulin doses in Diabetes" by Paul S. Moffitt

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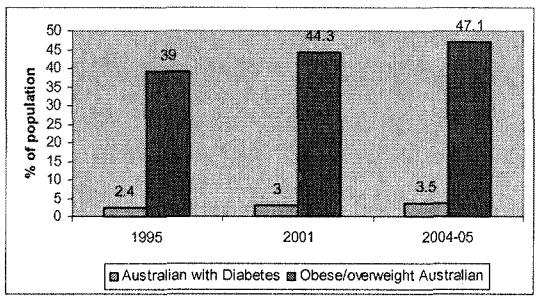
Overweight, Obesity and Diabetes
a growing worldwide epidemic!



	2000	2030
World	171,000,000	366,000,000
Australia	941,000	1,673,000
USA	17,702,000	30,312,000
UK	1,765,000	2,668,000

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TeleMedCare Pty Ltd
Unit 7, 6-8 Crewe Place
Rosebery, 2018, NSW, Australia
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TeleMedCare Ltd
United House,
Carlton Boulevard, Lincoln, LN2 4WJ
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Project Aims

- To investigate the correlation and relationship between blood glucose and the triaxial accelerometer sensor output.
- To investigate whether patients can estimate their own physical activity accurately.
- To obtain a robust model of blood glucose levels. Main focus: Markov Model.
- To evaluate whether self monitoring of energy expenditure is a useful adjunct to the management of Type II diabetes
- To test the insulin advisory algorithm derived from Diabetes Australia guideline.

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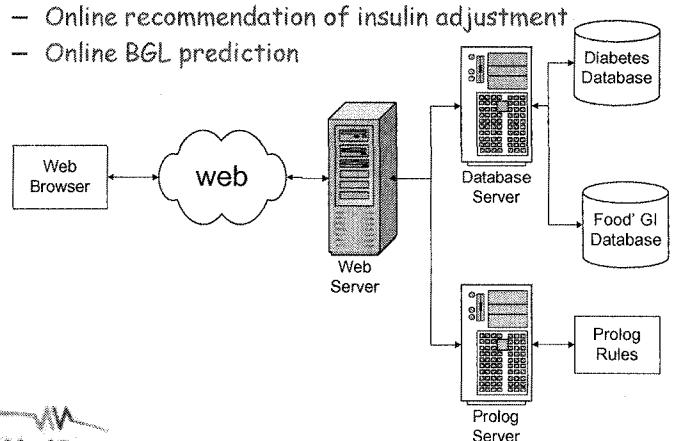
Technologies

- Web Server, Database, and Expert System
  - Online data collection
  - Online recommendation of insulin adjustment
  - Online BGL prediction



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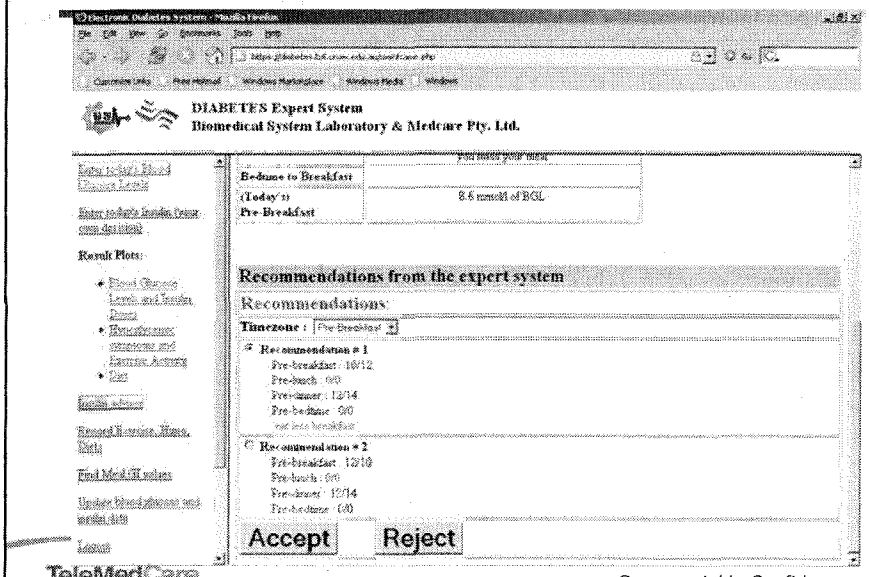
Web Services



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Use in Diabetes Management

- The Personal Coach Energy Monitor based on triaxial accelerometry , measures energy expenditure during daily normal physical activity, with an accuracy comparable to gas analysis.
- Physical activity has been shown to improve blood glucose control by improving glycogen storage, improving insulin sensitivity and contributing lower blood glucose levels in diabetics.
- A preliminary clinical trial was carried out with the assistance of the Prince of Wales Hospital Diabetes Centre to evaluate the use of Energy Monitor in helping to manage blood glucose levels in people with diabetes.

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Methods

- Five people with Type II diabetes were given the Energy Monitor and were trained on its use.
- For three months, they were required to wear the device, to monitor their daily energy consumption and to continue with their usual diabetes therapy.
- The body mass index (BMI) and glycosylated hemoglobin (HbA_{1c}) were recorded to measure any improvement in blood glucose control.
- The relationship between blood glucose levels (BGL) and measured energy levels were also investigated.

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Results

- Overall, a significant reduction of HbA_{1c} from $7.48 \pm 1.21\%$ to $6.98 \pm 1.44\%$ (p-value < 0.05) was observed.
- All five subjects who participated in the trial had a reduction on HbA_{1c} over three months, ranges from 0.2% to 1.0% reductions.
- No change in BMI was observed
- Higher levels of energy levels result in much smaller fluctuations in BGL when the type and quantity of food intake remained unchanged.

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Conclusions

- This small pilot study showed that the Energy Monitor can improve the management of diabetes by allowing people with diabetes to view and manage daily physical activity as an adjunct to their usual diabetes therapy.
- A much larger study is required to confirm the statistical validity of this preliminary trial
- Paper accepted for publication in Diabetes Technology and Therapeutics: "The Use of an Energy Monitor in the Management of Diabetes: A Pilot Study"

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DRAFT Project Proposal:

Evaluation of the Personal Coach for the management of overweight and obesity in Year 10 High School students

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Project design

- Project duration of one year
  - Monitoring period of six months
  - Enrolment period of six months (40/week/school)
- Test group: 1000 Year 10 High School Students, both male and female
- Control Group - same as above
- Control Groups and Test Groups in 50 DIFFERENT schools, matched on socio-economic status
- Test group supplied with;
  - Personal Coach energy monitor
  - Access to personal health education and lifestyle management web site
  - Membership of a Health "Face Book" to create a "virtual community" of participants

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Why Year 10 Students?

- Highly computer literate
- Highly status conscious
- Highly aware of personal attributes relative to peer group
- Susceptible to peer group pressure
- Academic pressure moderate in year 10
- Cognitive processes maturing - can instill patterns for future health behaviour

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Variables recorded

- At Start and End of 6 month project
  - BOTH Test and Control Group
  - Body weight, BMI, BGL, HbA_{1c}, Blood Pressure, Lung Function, single lead ECG, personal health history, Framingham & Baker Institute cardiac risk profile
  - Questionnaires on health status, depression etc
- Test Group supplied with Personal Coach and other lifestyle Management support
- Control Group - normal lifestyle

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Pre trial preparation
(three months)

- Development and testing of user interfaces optimised for use by Year 10 students
- Development of "motivational tools" to maximise benefit of the intervention
  - Review/input from clinical psychologists
- Complete end to end testing of system prior to trial start
  - Technical trial of 20 participants

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Trial execution

- 40 test and 40 control group participants enrolled in two different schools matched according to socio economic status, every week for 25 weeks
- All participants undergo baseline testing using the TeleMedCare Occupational Health system
- Test group provided with the Personal Coach and enrolled on the web
- All enrolled Test group participants begin trial
- Both Test and Control groups re-do baseline tests at the end of six months
- Clinical Trial completed within approximately one year

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Post Trial Period

(six months)

- Participants retain use of Personal Coach
- Post trial activities
  - Data collation
  - Data analysis
  - Preparation of final report
  - Preparation of journal papers
- Total duration of trial 3 + 12 + 6 = 21 months
- Key output parameters:
  - Adherence to trial protocols
  - Impact on health and wellbeing parameters

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Project Participants

- State or Federal Government
  - Sponsor
- University of NSW Biomedical Systems Laboratory
  - Clinical Trial Lead
- TeleMedCare Pty Ltd
  - System Integrator

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Indicative budget

• Clinical Project Team	
– Project Director 2y x In Kind (UNSW)	$180
– Systems Integration 2y x In Kind (TMC)	$160
– Project Manager 2y x $80K	$160K
– Nurse clinician lead, 2y x $70K	$140K
– Research Assistant, 2y x $60K	$120K
• Baseline Monitoring System	
– TMC OHS, 2 y lease x $10K	$20K
• Personal Coach + web services	
– 1000 students x $100 (Personal Coach)	$100K
– 1000 students x $72 per year (web ervices)	$72K
• TOTAL	$952K

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Review of available tools:

Evaluation of the Personal Coach for the management of overweight and obesity in Year 10 High School students

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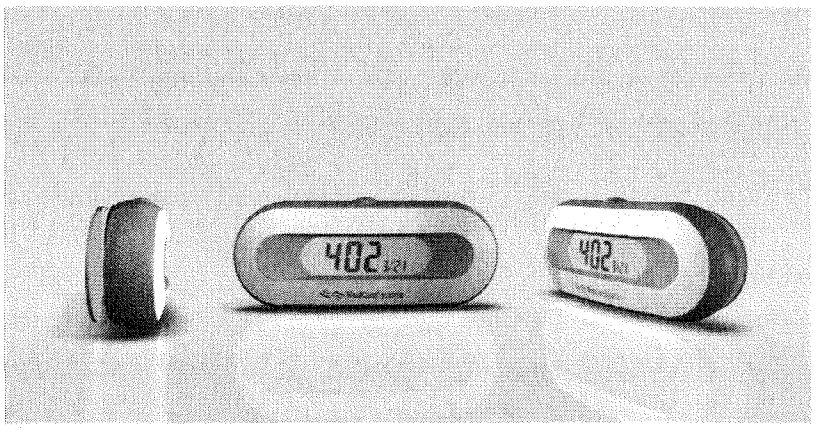
The Personal Coach Energy Monitor



- Ergonomically designed – easy to use!
- Feature rich - Multiple modes of operation
- Monitors energy use continuously
- Much more accurate than pedometers

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TeleMedCare Pty Ltd
Unit 7, 6-8 Crewe Place
Rosebery, 2018, NSW, Australia
www.telemedcare.com.au

TeleMedCare Ltd
United House,
Carlton Boulevard, Lincoln, LN2 4WJ
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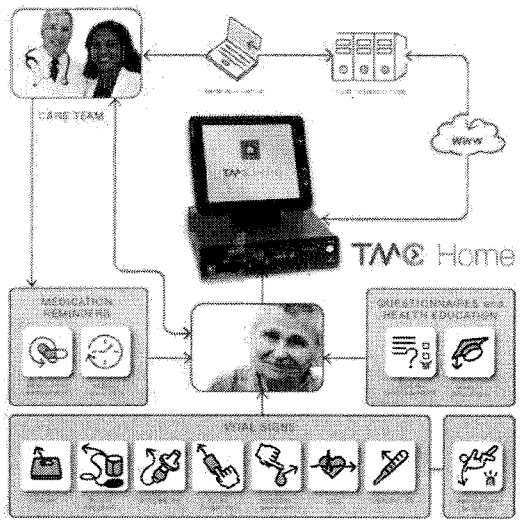
TeleMedCare Clinical Monitor for the recording of baseline parameters



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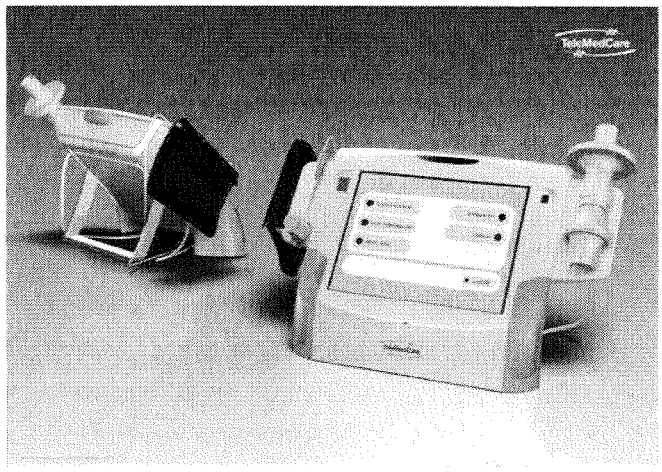
New Generation Systems!

(Available Aug. 2008)



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Facilities for Obtaining Baseline Measures

- TMC OHS - Some Features;
  - Blood pressure, ecg (1 or 12 lead), spirometry, pulse oximetry, body weight, body temperature
  - Health education
  - Large Range of Health and Risk Analysis Questionnaires
  - Clinical decision support
  - Biometric identification
  - Full range of Point of Care diagnostic devices
  - Web enabled electronic health records
  - High definition wireless capture of digital images

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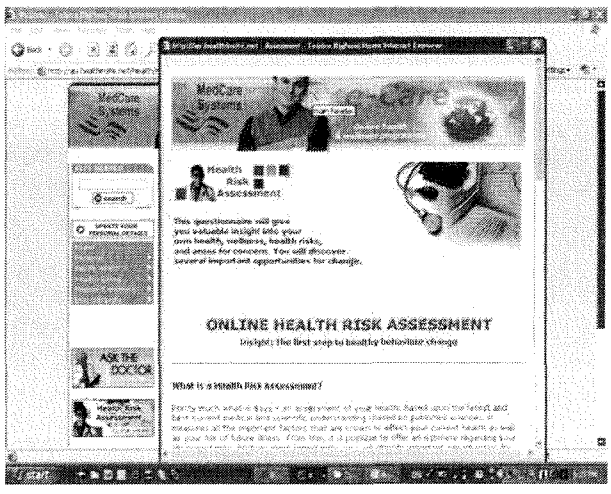
Web based Lifestyle Management and health education



- Patient web portal for;
  - Data viewing
  - Health education
  - Personalised lifestyle management according to personal risk factors

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TeleMedCare Pty Ltd

Submission to Standing
Committee on Obesity, 11th June 2008

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