Proposal Name: Maternal Mortality Reduction

Submitted by: Dr. M. Christopher

Please provide a description of the proposal (up to 500 words):

Maternal mortality in the globe is 251 per 100,000 live births. In India the maternal mortality rate is 254 per 100,000 live births. Anaemia and diabetes complicating pregnancies are alarming and preventable.

Mass surveillance, early diagnosis and global health planning are the need of the hour for safe motherhood. I have invented a non invasive Haemoglobin and blood sugar analyzer. It is non prick technique, chemical free and instant device.

Goals are global improvement of the health of mother and new born; global reduction of the morbidity in pregnant mother and new born; use of non invasive instant low cost analyzer for haemoglobin and blood sugar estimation; mass surveillance of haemoglobin and blood sugar with my pioneer innovative technology which is user friendly and chemical free; early diagnosis of anaemia and diabetes at monthly interval during pregnancy thereby preventing anaemia complicating pregnancy and diabetes complicating pregnancy.

The cost of the analyzer is one lakh Indian rupees. I am working on it to reduce the cost of the analyzer to ten thousand to twenty thousand Indian rupees. By reducing the cost, the analyzer can be made available in all the hospitals, primary health centres and in public places for mass surveillance and early diagnosis of Anaemia and Diabetes.

Describe and justify the potential public health impact of the proposal:

There is global concern of maternal mortality. Major share of the health budget is being spent for diagnostics. A test for haemoglobin and blood sugar costs 100 INR. Early pregnant mothers need several number of times of blood tests for haemoglobin and blood sugar estimation.

The painful prick of the blood tests prevents regular follow up blood tests especially among illiterate and poor pregnant mothers.

The increasing mortality and morbidity due to anaemia and diabetes complicating pregnancy can be prevented by low cost, effective diagnostic tests. My novel innovative device ‘Non invasive haemoglobin and blood sugar analyzer’ will solve this crisis.

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1 Principally CEWG criterion 1 but others may be relevant e.g. Equity/distributive effect including on availability and affordability of products and impact on access and delivery.
Describe and justify the **technical feasibility**¹ of the proposal:

Instant haemoglobin and blood sugar levels are made possible with this innovative device. I have been awarded L-RAMP award 2007 for this concept (A joint venture of Lemelson Foundation, USA and Indian Institute of Technology, Madras, India) by Dr. APJ Abdul Kalam, the then president of India, who said that he was impressed by the analyzer and the analyzer will address the global lacuna of health care system. The concept has been approved by science and technology of Government of India.

The patient will put the finger in the analyzer over a light source. The transmitted light passes through a series of prisms and the emergent spectrum is photographed and analyzed for RGB estimation and wavelength measurement. Software is coded with pre determined values with values of constants to take into consideration of tissue, bone interferences. Instant results of hemoglobin and blood sugar are displayed on monitor.

This is a pioneer innovative technology of non invasive instant Hemoglobin and blood sugar. A new era in the history of medicine. This innovative technology will help to improve, prevent and treat maternal diabetes and anemia among women and newborns in poor, rural communities.

Describe and justify the **financial feasibility**² of the proposal:

The cost of this innovative device is one lakh INR. I am working on this innovative device to reduce the cost to ten thousand INR to twenty thousand INR. The light source, spectral capturing device and wavelength sensor need further innovations for low cost and global applicability.

For every pregnancy routine periodic estimation cost for haemoglobin and blood sugar analyzer will be about one thousand to two thousand INR. World birth rate is 2.02% meaning that there are at least 103,756,863 women pregnant at any time. The approximate annual expenditure on these investigations for pregnant population of the globe would be 10,376 Crores INR.

Since this innovative device is chemical free, the cost of every test will be zero. So the medical budget for laboratory chemicals can be reduced and the budget can be diverted to other needy area of concern.

Describe in what way the proposal addresses **cross-cutting issues**³:

Maternal anaemia and diabetes has direct impact on neonatal mortality rate. Still born deliveries are common among uncontrolled maternal diabetics. Maternal anaemia leads to cardiac failure and even death. Early diagnosis and management of anaemia and diabetes with this device reduces maternal mortality and neonatal mortality.

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¹ Principally CEWG criterion 4 but others may be relevant e.g. Rational and equitable use of resources/efficiency considerations
² Principally CEWG criterion 5 but others may be relevant e.g. Cost-effectiveness.
³ “Cross-cutting Issues” refers principally to CEWG criteria 7-12, if not addressed elsewhere in the submission e.g. Potential for delinking R&D costs and price of products.
Identify key steps necessary to begin implementation and key issues to be resolved for implementation to begin:

My innovation device which costs one lakh INR has to be designed to cost ten thousand INR per monitor for mass surveillance.

Provide the evidence base for the proposal including literature references and other relevant information:

Given below.

NON INVASIVE INSTANT HAEMOGLOBIN AND BLOOD SUGAR ANALYSER

PROOF OF SCIENCE BEHIND AND FEASIBILITY OF THE INVENTION

Incident light ray is passed through finger. The refracted ray passes through serial prisms through a scope. The emergent spectrum is picked up by a camera or spectral image sensor and the data are analysed for Red, Green, Blue values and also for the Wavelength. The pointer picks up the values at 3 places. One at the Centre of the spectrum and the other at both periphery at a definite X & Y axis.

The data are analyzed and calculated with a derived constant and formula. Instant reports of estimation of Haemoglobin and Blood sugar will be displayed in the monitor. The derived constant is used to nullify bone, tissue, blood vessel interferences.

Interferences

1. Melanin interference
2. Bone, tissue, venous vessels interference.

Melanin
Root of the nail does not have melanocytes. So there is no melanin. The light source can be positioned at the level of the root of the nail in the finger probe.

Proof

Nail Anatomy

By Heather Brannon, MD, About.com

Updated: September 25, 2004

About.com Health's Disease and Condition content is reviewed by the Medical Review Board

Nail Root

The root of the fingernail is also known as the germinal matrix. This portion of the nail is actually beneath the skin behind the fingernail and extends several millimeters into the finger. The fingernail root produces most of the volume of the nail and the nail bed. This portion of the nail does not have any melanocytes, or melanin producing cells.

Bone tissue, pigmentation and venous vessels normally absorb constant amount of light over time. A constant can be derived and used in the calculation.

Proof

OPERATOR’S MANUAL

NPB-40

Nellcor Puritan Bennett Inc. is a wholly-owned subsidiary of Mallinckrodt
Bone, tissue, pigmentation, and venous vessels normally absorb a constant amount of light over time.

Oxy Haemoglobin and Deoxy Haemoglobin in skin can be estimated by multi channel visible spectrum by using inverse optical scattering technique.

References

Francisco H. Imai
Munsell Color Science Laboratory
Rochester Institute of Technology,
54 Lomb Memorial Drive, Rochester, NY 14623-5604, USA

Map of skin components from absolute spectral reflectance image obtained by multi-channel visible spectrum images based on the inverse optical scattering analysis

In the photometric stereo technique, four illuminants are used, and an image is taken by each illuminant. The pixel values in the obtained several images are used to calculate the absolute spectral reflectance and normal vector of the surface on the corresponding pixel. The index finger where the second joint was bind by a string was captured and analyzed by the proposed technique. The results show that the components are extracted in the wide range of the finger.
2. Wave length measurement methods

1. CNT – 91 R frequency calibrator (Pendulum instruments).
2. Erbium doped fiber amplified to increase signal level.
4. Electro optical measurement

I have opted for electro optical measurements.

3. Scientific Basis

1. Beer’s law

When a beam of monochromatic radiation is passed through a solution of an absorbing substance, the rate of decrease of intensity of radiation with thickness of absorbing solution is proportional to the intensity of the incident radiation as well as the concentration of the solution.

The concept of analysis is based on Beer’s law

\[ L(\text{Out}) = L(\text{In}) = (D.C.a.) \]

Where

- \( L \) - Intensity of light
- \( C \) - Concentration of solute
- \( D \) - Distance the light travels through the solution
- \( A \) - Absorption coefficient of solute.

Proof

[www.springerlink.com/index/2936240706742Px1.pdf-similar_pages by G. Yoon-2005 cited by 3 versions.]
Robust design of finger probe tools in non invasive total haemoglobin spectrum of whole blood with haemoglobin concentration... times Fig. 3. Example of life transmitted through finger at 5...

The first term... CD, is the Beers law expression for absorb... tissue and its application from Yonsei University. Measurement of non invasive blood components such.

Spectral Wave length of blood sugar and Haemoglobin .

Normal value

The wave length used in the transmitter is 500 – 1100 nm

Blood glucose 800 – 1100 nm

Haemoglobin 500.9 nm – 561.1 nm

Wave length of emergent spectrum and wavelength of the corresponding blood sample will be measured. Comparative and analytical study of the data will be done.

Proof of various studies done by different researchers

i. Non invasive instant Haemoglobin analysis

Proof


[0027]The device may be adapted for use, with any body part although it is preferable that it can be a finger or thumb.
The wavelength used in the transmitter fibres will generally be from 500 to 1100 nm. However, it is a further feature of the invention to provide a detector as hereinbefore described which also measures haemoglobin index (HbI) and/or oxygen saturation (SO2) of blood. For such measurement, specific wavelengths are used, namely 500.9 nm, 528.1 nm, 549.5 nm, 561.1 nm, 572.7 nm and 586.3 nm. The preferred wavelengths for measuring blood glucose are from 800 nm to 1100 nm.

Buying a used simca ariannewere acquired non-destructively through the skin and scales in diffuse ... Spectra were analyzed using Principal Component Analysis (PCA) and Soft ..... The light is diffusely reflected through the different tissue layers and is collected ..... Non-invasive monitoring of haemoglobin conc

ii. Non invasive Blood Sugar Analysis

Proof

2001 Mallinckrodt Inc. All rights reserved. 060328B-0601PDF] The Pursuit of Noninvasive Glucose: “Hunting the Deceitful Turkey ... - 3:55am File Format: PDF/Adobe Acrobat - View as HTML By way of a definition, then, noninvasive blood glucose monitoring ... There are lots of sources, especially on the Internet, where noninvasive .... amount of glucose by shining light through the skin and measuring the response. ...

www.mendosa.com/noninvasive_glucose.pdf - Similar pages

To contact Mallinckrodt’s representative: In the United States, call 1-800-635.5267; outside of the United States, call your local Mallinckrodt representative. Non-invasive continuous blood glucose monitoring - US Patent ...Thus, there is a need for continuous non-invasive blood glucose monitoring for use ... between non-glucose sources and to extract a faint glucose spectral signature. ... These include: Thermoscan Instant
Thermometer Model No. ..... of body fluid constituents through measuring light reflected.

**Optical measurement of glucose levels in scattering media** Yoon, G.; Amerov, A.K.; Kye Jin Jeon; Ju Byung Kim; Yoen-Joo Kim Engineering in Medicine and Biology Society, 1998. Proceedings of the 20th Annual International Conference of the IEEE Volume 4, Issue, 29 Oct-1 Nov 1998 Page(s):1897 - 1899 vol.4 Digital Object Identifier 10.1109/IEMBS.1998.746967 Summary: A method for non-invasive determination of blood glucose on the basis of selective spectral analysis of reflected from or transmitted through biological tissues containing blood is demonstrated. Our proposed algorithm is based on a discrete number of wavelengths. The wavelengths are selected such that the measurements of glucose levels can be most sensitive and such that the influences of other substances such as water, skin, etc. may be minimized. A compact instrument is developed for measurement. Verifications of the algorithm are successfully accomplished using scattering solutions whose glucose concentrations varied up to 1000 mg/dl

**Blue, Green, Red in spectral analysis of Haemoglobin and Blood sugar Non invasively.**

**Proof**

**Camera in Photography of RGB of Haemoglobin and Blood sugar spectrum through finger.**

[www.nature.com/jcbfm/journal/v20/n3/full/9590901a.html](http://www.nature.com/jcbfm/journal/v20/n3/full/9590901a.html) - Similar pages.
In healthy adults, imaging of changes in hemoglobin saturation during hand ..... as seen by a change from blue-green to red, can be imaged in real-time using ..... Changes in local environment can alter the optical absorbance spectrum in a .... (1989) Time resolved reflectance and transmittance for the non-invasive ...

Proof

The web camera was fixed to one extreme of the holder, with its lens parallel to the surface ... 1 (a) Scheme of a computer screen photo-assisted platform, ... In the present context hemoglobin and blood were treated as separate indicators. ..... Accordingly, the same samples were evaluated by their rgb-colors when ...

www.rsc.org/delivery/_ArticleLinking/DisplayHTMLArticleforfree.cf m?JournalCode=AN&Year=2006&ManuscriptID...Iss=1 - Similar pages

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Future Perspective

❖ The proverb ‘no pain no gain’ is remodeled to ‘no pain but gain’ with this technology.
❖ Tearful millions of diabetics and pregnant mothers can have painless cheerful blood tests.
❖ I foresee the smiling faces of the Human race and blossom of new era in the history of medicine & a breakthrough in global health care.