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LETTER TO THE EDITOR

Continuous health monitoring: integrating biomarkers for the management of chronic diseases

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Abstract

With the recent progresses of the information and communication technologies, biosensors and nanotechnologies, the access to continuing health monitoring is becoming real. The development of efficient, accurate and interactive solutions integrating biomarkers for continuing health monitoring might contribute to an improved care of some chronic diseases like hypertension, diabetes or heart failure. Continuing health monitoring might also enhance the efficiency and safety of patient's treatments.

Keywords: Biosensors, hear failure, diabetes, BNP, diagnosis

Continuing health monitoring (CHM): new promises for management of chronic diseases?

Chronic diseases represent major health and economic threats around the world. An aging and expanding populations as well as high fat and/or poor diet represent some of the triggers of an increasing number of patients with chronic disorders. Diabetes and heart failure (HF), two diseases frequently related to hypertension, can illustrate this raise of chronic disorders. The rapid increase in diabetes mellitus prevalence is alarming, affecting all age groups across most ethno-geographical boundaries (Grundy et al. 2005, Meetoo et al. 2007, Wild et al. 2004, Wild and Forouhi 2007). Diabetes is associated with higher risk for developing micro-angiopathy and cardiovascular complications and to a major impact for healthcare economy (Cooper et al. 2001, Cooper and Johnston 2000). Heart failure (HF) is becoming increasingly common and more than 20 millions people worldwide are estimated to have heart failure (Rosamond et al. 2007). HF is a deadly and costly disorder, carrying an overall worse prognosis than cancer (Stewart et al. 2001) and the economical impact of heart failure is also important (Dunlay et al. 2011, Stewart et al. 2002). To facilitate a real time disease management and to improve the detection of acute phases of patients with diabetes and HF, the needs for more continuous monitoring of vital signs, weight, symptoms and biomarkers is raising (Adamson 2006, Di et al. 2006, Kashem et al. 2006, Mazze et al. 2011, Penfornis et al. 2011). Continuous health monitoring (CHM) is based on the integration of mobile computing technologies and health to facilitate the communication of data among patients, physicians, and other health care workers (Bruls et al. 2009). CHM is also offering new promises for the monitoring of treatment efficiency and safety.

How innovative technologies and biomarkers integration can support CHM?

The attraction for CHM is growing because of our modern environment made of mobile devices and wireless communications but also because of the raise of nanotechnologies and biosensors. Our new wifi 'biotope' is

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therefore a key feature to allow the continuing measurement of vital parameters and biomarkers through various biosensors and to transfer the recorded/monitored data to the physician office and data centers. The recent progresses of the information and communication technologies allow also the physicians to monitor their patients through mobile message services or smartphone applications in different locations. The evolution of biosensors is also playing a key role in the emergence of CHM. Biosensors are used in electronics-based medical equipment to convert various forms of stimuli into electrical signals for analysis (Bruls et al. 2009). Biosensors advantages include low-power integrated circuits, low-cost, nano-size, lightweight and intelligent communication nodes. Biosensors have been first developed to monitor parameters like temperature, humidity, pressure, wind direction and speed, illumination intensity, vibration intensity, sound intensity, power-line voltage, chemical concentrations or pollutant levels and are now designed for the continuous monitoring of vital body functions (Bruls et al. 2009). Recently, new biosensors have permitted the integration of more biomarkers such as cardiac biomarkers (troponin and natriuretic peptides) or glycaemia, which may leverage new applications for the care of patients with diabetes and heart failure and for monitoring the treatment efficiency. Thus, functionalized ZnO nanowire arrays based sensor are enhancing the wireless remote monitoring of glucose through (Ali et al. 2011). The development of specific optomagnetic biosensor for a rapid, high sensitivity and point-of-care test for cardiac troponin is offering new perspectives for the management of cardiovascular disorders (Dittmer et al. 2010). Interestingly, some new biosensors also consist in rapid integrated multiplexed immunoassays, based on actuated magnetic nanoparticles, and can provide new hopes for multi-factorial diseases of multi-marker strategies (Bruls et al. 2009).

CHM: new hopes, new challenges

CHM is providing new hopes to the medical community and to politicians. CHM might contribute therefore to maintain stable chronic diseases like diabetes and heart failure but also reduce the number of visits to physicians' offices and hospital stays and to improve treatment monitoring. CHM might also lead to a reduction of the transmission time of clinical alerts and early detection of acute phases of diseases. CHM is offering several other advantages like improving the connection between patients and physicians, stimulating more involvement and responsibility of the patients in their own care and decreasing some healthcare costs. However, multiple challenges are still paving the way of a prime time use for CHM. The first one is the need to provide education and training about these new technologies and their use to physicians and patients. Second, the success of CHM will rely on the motivation and compliance of the patients as well as on an efficient self-management to avoid potential human errors. Third, the analytical accuracy and the clinical value of the biomarkers and biosensors used for CHM initiatives will have to be confirmed. Lastly, the cost-effectiveness of CHM will have to be determined with large transversal studies.

In conclusion, the recent progresses of the information and communication technologies, biosensors and nanotechnologies are triggering the use of continuing health monitoring. The development of efficient, accurate and interactive solutions integrating biomarkers for continuing health monitoring might contribute to an improved care of some chronic diseases such as diabetes and heart failure and to enhance the monitoring of treatment efficiency and safety. Nevertheless, several barriers like the validation of the analytical, clinical and economical performances remain to be broken before a broader community use.

Declaration of interest

The authors report no declarations of interest.

References

Adamson PB. (2006). Integrating device monitoring into the infrastructure and workflow of routine practice. *Rev Cardiovasc Med* 7 Suppl 1:S42–S46.

Ali SM, Aijazi T, Axelsson K, Nur O, Willander M. (2011). Wireless remote monitoring of glucose using a functionalized ZnO nanowire arrays based sensor. *Sensors (Basel)* 11:8485–8496.

Bruls DM, Evers TH, Kahlman JA, van Lankvelt PJ, Ovsyanko M, Pelssers EG, Schleipen JJ, de Theije FK, Verschuren CA, van der Wijk T, van Zon JB, Dittmer WU, Immink AH, Nieuwenhuis JH, Prins MW. (2009). Rapid integrated biosensor for multiplexed immunoassays based on actuated magnetic nanoparticles. *Lab Chip* 9:3504–3510.

Cooper ME, Bonnet F, Oldfield M, Jandeleit-Dahm K. (2001). Mechanisms of diabetic vasculopathy: an overview. *Am J Hypertens* 14:475–486.

Cooper ME, Johnston CI. (2000). Optimizing treatment of hypertension in patients with diabetes. *JAMA* 283:3177–3179.

Di Serio F, Lovero R, Leone M, De Sario R, Ruggieri V, Varraso L, Pansini N. (2006). Integration between the tele-cardiology unit and the central laboratory: methodological and clinical evaluation of point-of-care testing cardiac marker in the ambulance. *Clin Chem Lab Med* 44:768–773.

Dittmer WU, Evers TH, Hardeman WM, Huijnen W, Kamps R, de Kievit P, Neijzen JH, Nieuwenhuis JH, Sijbers MJ, Dekkers DW, Hefti MH, Martens MF. (2010). Rapid, high sensitivity, point-of-care test for cardiac troponin based on optomagnetic biosensor. *Clin Chim Acta* 411:868–873.

Dunlay SM, Shah ND, Shi Q, Morlan B, VanHouten H, Long KH, Roger VL. (2011). Lifetime costs of medical care after heart failure diagnosis. *Circ Cardiovasc Qual Outcomes* 4:68–75.

Grundy SM, Cleeman JI, Daniels SR, Donato KA, Eckel RH, Franklin BA, Gordon DJ, Krauss RM, Savage PJ, Smith SC Jr, Spertus JA, Costa F; American Heart Association; National Heart, Lung, and Blood Institute. (2005). Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. *Circulation* 112:2735–2752.

Kashem A, Cross RC, Santamore WP, Bove AA. (2006). Management of heart failure patients using telemedicine communication systems. *Curr Cardiol Rep* 8:171–179.

Mazze R, Akkerman B, Mettner J. (2011). An overview of continuous glucose monitoring and the ambulatory glucose profile. *Minn Med* 94:40–44.

Meetoo D, McGovern P, Safadi R. (2007). An epidemiological overview of diabetes across the world. *Br J Nurs* 16:1002–1007.

Penfornis A, Personeni E, Borot S. (2011). Evolution of devices in diabetes management. *Diabetes Technol Ther* 13 Suppl 1:S93–102.

Rosamond W, Flegal K, Friday G, Furie K, Go A, Greenlund K, Haase N, Ho M, Howard V, Kissela B, Kissela B, Kittner S, Lloyd-Jones D, McDermott M, Meigs J, Moy C, Nichol G, O'Donnell CJ, Roger V, Rumsfeld J, Sorlie P, Steinberger J, Thom T, Wasserthiel-Smoller S, Hong Y; American Heart Association Statistics Committee and Stroke Statistics Subcommittee. (2007). Heart disease and stroke statistics–2007 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation* 115:e69–171.

Stewart S, Jenkins A, Buchan S, McGuire A, Capewell S, McMurray JJ. (2002). The current cost of heart failure to the National Health Service in the UK. *Eur J Heart Fail* 4:361–371.

Stewart S, MacIntyre K, Hole DJ, Capewell S, McMurray JJ. (2001). More 'malignant' than cancer? Five-year survival following a first admission for heart failure. *Eur J Heart Fail* 3:315–322.

Wild S, Roglic G, Green A, Sicree R, King H. (2004). Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care* 27:1047–1053.

Wild SH, Forouhi NG. (2007). What is the scale of the future diabetes epidemic, and how certain are we about it? *Diabetologia* 50:903–905.