

**Non-invasively obtained Central Blood Pressure:
Barriers and Strategies to its Use in Practice**

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**This thesis is submitted in total fulfilment of the
requirements for the degree of Doctor of Philosophy**

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December 2012

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Abstract

Recently, novel concepts and medical technologies have developed rapidly with enormous growth and unprecedented expansion in the range of interventions and knowledge offered for health professionals in their clinical decision making. This burgeoning innovation has not necessarily resulted in an incremental availability of knowledge to policymakers and clinicians. In this study critical translation gaps have been addressed strategically in the research-into-action cycle to improve outcomes and services.

Given widespread acceptance that waveform morphology and blood pressure (BP) differ considerably between the central aorta and peripheral arterial system, it is clear that BP measurements in the peripheral arteries cannot serve as direct substitutes for their central counterparts. Although non-invasive BP measured in the brachial artery (cuff BP) is the basis for the present management of hypertension, central blood pressure (CBP) has been shown to be the better predictor of cardiovascular outcomes than cuff BP. Consequently, there are substantial research efforts to develop non-invasive estimating methods for CBP, mainly based on the technique of applanation tonometry. However, CBP measured has not been widely adopted in clinical practice. One of the possible gaps is that tonometry-based measurement requires some skills and time to perform and it is a relatively expensive technique. Besides, the accuracy of the current tonometry-based techniques has been questioned. To identify and address the gaps of translating the evidence of the importance of CBP, a series of studies were conducted.

To identify existing gaps, I carried out a systematic review and meta-analysis of studies comparing tonometry-based CBP estimates with invasively measured central BP and found that present tonometry-based CBP estimating methods are acceptable

in theory, with small errors. However, there is substantial room for improvement in measurement accuracy of CBP.

To develop a more accurate, less expensive, and less technically dependent CBP measurement technique, the pulse wave analysis (PWA) technique for brachial pulse volume plethysmography (PVP) waveforms from an oscillometric blood pressure monitor was implemented. Evaluation demonstrated that large random and systematic errors are introduced into the central pulse pressure (PP) estimates when they are calculated as the difference between the estimated central systolic BP (SBP) and central or cuff diastolic BP (DBP), which can be improved substantially with the novel PWA approach. Subsequently, the novel technique was seamlessly incorporated into a standalone automatic BP monitor. In a rigorous validation study, it was demonstrated that CBP can be measured accurately by this stand-alone automatic blood pressure monitor.

To apply the CBP concept in clinical practice, the gap between innovation and clinical application should be closed. The diagnostic threshold for confirming a diagnosis of hypertension with CBP has never been proposed; I therefore derived and validated the diagnostic threshold of CBP based on two independent event-based cohorts with long-term follow-up.

With the proposed cut-off limits for the diagnosis of hypertension, the diagnostic accuracy of the stand-alone CBP monitor reference to invasively measured CBP was estimated. It was then suggested that traditional cuff BP may be reliable in confirming the diagnosis of hypertension and in justifying subsequent treatment with its high specificity. However, because of low sensitivity, the cuff BP could render possible management inaccessible to a considerable proportion of hypertensive subjects, who may be identifiable through the noninvasive CBP monitor.

Finally, in responding to the gap between clinical application and policy, a health economic evaluation was required to support the cost-effectiveness of the new emerging technique. A comprehensive Markov modelling was performed and this confirmed the cost-effectiveness of CBP monitoring, which resulted from a greater quality gain that outweighed its supplementary cost. Given more data supporting the diagnostic and prognostic role of CBP, it should be considered to be an effective strategy for the management of hypertension.

Declaration

NAME: Hao-min Cheng

PROGRAM: Doctor of Philosophy

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Acknowledgments

I would like to acknowledge and extend my heartfelt gratitude to the following persons who have made the completion of this thesis possible:

My principal supervisor, Professor Alan Pearson for his vital encouragement, guidance, and support which, from the beginning to the final level, enabled me to complete the PhD.

My associate supervisor, Professor Jonathan Karnon, for his guidance and instruction in the health economic analysis and the construction of the complex mathematic Markov modelling.

My associate supervisor, Professor Stephen Grant Worthley, for his support of my PhD study.

The statistician, Mr. Thomas Sullivan, for assisting in data analysis

For the systematic review, I am grateful to the following: Mr. Michael Draper, for formulating search strategies; and Dr. Mustafa Karamanoglu, for providing his data for my review synthesis. This work was supported by the scholarship for 2011 overseas training from Executive Yuan, Republic of China (0980004399) and IPRS-APA 2011 Scholarship (1214836) at the University of Adelaide from the Australian Government.

For the health economic analysis, I am grateful to Ms. Kate Lovibond and Dr. Sue Jowett of the National Clinical Guideline Centre and the Royal College of Physicians, London, UK for providing me with the original Markov model published in 2011.

All Joanna Briggs Institute, Library, Research Education and Development staff for providing practical help in the completion of this PhD.

Most especially to my family and friends.

And to God, who makes all things possible.

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