Adaptive Health Management Information Systems

Concepts, Cases, and Practical Applications

FOURTH EDITION

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with

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(& Joshia Tan)

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15401-6

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Cover Image (Title Page, Part Opener, Chapter Opener): © phasin/Getty Images and © gonin/Getty Images
Printing and Binding: Sheridan Books
Cover Printing: Sheridan Books

Library of Congress Cataloging-in-Publication Data
Library of Congress Cataloging-in-Publication Data unavailable at the time of printing.
LCCN: 2019946986

6048

Printed in the United States of America
23 22 21 20 19 10 9 8 7 6 5 4 3 2 1

Contents

New to This Edition

Adaptive Health Management Information Systems, Fourth Edition, is for those instructors needing and wanting to keep pace with rapidly evolving perspectives in the field of healthcare management information systems (HMIS) and e-health digitalization. Not just a regular update of the previous edition, this new edition is vastly reorganized, revised, and reformatted with numerous contributed pieces from experts in all HMIS-related fields. To improve the previous edition, we have added much needed discussions in contemporary topics, such as precision medicine, digital health commercialization, pharmacy informatics, big data analytics, and AI (artificial intelligence). Therefore, this new edition, containing new motivating scenarios related to digital health technology applications, is also packed with creative developments and designs of real-world examples; stimulating chapter questions; glossary; illustrative graphics, tables, and exhibits; and additional readings. Significant updates and complete revisions have been incorporated throughout the text—so much so that readers familiar with the previous editions of this work would not have recognized this work as a derivative of the previous ones.

Specific updates:

- **Content.** Rich, extensive coverage of topics in HMIS and Health IT/IS domains across all dimensions, with contemporary perspectives, emerging technological applications, and implementations from developed and developing countries to serve as examples in enhancing the understanding of topics.
- **Scenarios.** Real-world, realistic scenarios set the stage for topic discussion and motivate student readers. A short reflection is also provided at the end of each scenario to develop students' imagination.
- **Technology Reviews.** Background readings on technological topics to enhance understanding of contemporary research and developments in Health IT/IS domains.
- **Policy Reviews.** Background readings on policy-related areas to enhance understanding of policy implications for trends in Health IT/IS domains.
- **Mini-Cases.** Reflective readings for students to draw lessons from various parts of the major sections of the text.
- **Chapter Questions.** Short and long questions to stimulate classroom discussion and promote learning of various topics discussed in the text.
- **New Major Cases.** A range of relevant new cases to enhance understanding of the materials and promote further interactions among students and between student groups and instructors.

Dedication

To the memory of all those loved ones, who have since passed away as I worked through various editions of this enduring text; to my students and colleagues, who have contributed to my near 30 years of teaching and learning; and those who have enjoyed my works in the fields of health services administration, health informatics, business and e-health information systems, e-Business informatics and strategies; and to my inner and expanding circle of friends and relatives, especially my own beloved family members who have all assisted me one way or another to hone my thinking and fuel my lengthy academic publishing and writing career.

—Joseph Tan

Acknowledgments

Above and beyond those to whom I am indebted while assembling previous editions of this text, I must acknowledge the generous help of those newly added academic and professional contributors, including those who were brought on board by my co-editor, Dr. Philip Olla. Dr. Olla has personally assisted in revising parts of the writing of various contributed pieces in this new edition. Sincere gratitude is also to Mr. Joshia Tan for his insights and copyediting efforts in making this revised edition not only a more appealing text, but one that would be more readable and valuable for both students and instructors.

There are several individuals whom I must especially thank: first, the publisher, who swiftly agreed to the need for an update of the text, and very patiently waited for the contributions to come in, who was flexible with the submission of the final overdue manuscript when loved ones passing away caused delays, when there were challenges connecting with some of the previous contributors, and when awaiting new contributors to complete their follow-up revisions after receiving feedback from the editorial team members (myself, Olla, and Josh). Finally, several of my students (Dr. Michael Dohan, Chloe Nyitray, Grace Simpson, Brandon Nixon, and Mr. David Pellizzari) also collaborated at different times for adding the new content of the book.

I am thankful to all who contributed for volunteering their time, efforts, and patience with my ongoing disruptive returns to them for more details and changes, and I am also particularly grateful to my wife, Leonie Tan, and son, Joshia Tan, who have ceaselessly encouraged me in every way possible to go on with my revising the text when all of us were going through very challenging times of overseeing the passing away of two beloved brothers—one, my own elderly brother, Paul and the other, my wife's younger brother, Peter—throughout the duration of this project.

To all of these individuals and to my family members, friends, students, and relatives, I offer my many thanks for the support and encouragement provided to me. Much of the value of this work is due to their contributions and assistance.

—Joseph Tan

Foreword

Dr. & Professor Norm Archer
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As you can see from the chapters in this volume, we are living in times where there are rapid advances in information and communication technologies (ICT). These may surpass our ability to quickly adapt them to meet practical needs. Health care often lags in terms of technology adaptation. This is due to a variety of barriers, but technology can provide some solutions:

- In the absence of widespread accepted standards, initial surges of HMIS development resulted in the growth of information silos that cannot intercommunicate. Efficient service provision requires information sharing. This problem is slowly being overcome by interoperability solutions. A less expensive solution is the DHIS 2 (District Health Information System) open source system. It is in use in 60 countries, including 40 countries in Africa, Asia, and Latin America. Many have adopted DHIS 2 as a nationwide standard, thus eliminating problems such as interoperability, retraining mobile staff, and healthcare system integration.
- The adoption of new technology supports rapid and efficient record keeping, data retrieval, communications, and applications in a variety of devices, resulting in massive floods of (Big) Data about patient health and management. A barrier is often a lack of trained and experienced staff to organize these data and to develop efficient methods that use health data analytics, including machine learning and/or decision support through deep learning.
- A barrier in many healthcare institutions is that they have been distracted by data breach and data hostage problems, requiring much time and money to be spent on improving data security. A resulting side benefit is better management of patient privacy.
- Precision medicine looks promising, and has been used effectively in some cases. A barrier is the high cost of specialized molecules to treat small groups of people, resulting in unaffordable treatments. There is no practical solution in sight as of yet.
- Personal computing has radically changed the dynamic of written communications. But physicians now work longer hours to do tasks formerly done by assistants. This barrier prevents spending sufficient time with patients; as a result, the strongest predictor of physician burnout is the amount of time spent doing computer documentation. Artificial intelligence (AI) solutions may eventually be able to reduce this documentation load.
- Computer system support affects physicians through work structuring, thereby reducing practice flexibility. This is not necessarily a barrier; well-designed systems may in fact help physicians to make better decisions from evidence-based medicine, improving care quality.

- Intelligent digital assistants, such as Alexa and Cortana can understand voice and be activated by voice commands to accomplish basic tasks. This improves user adaptability, and may take over some of the documentation needs of healthcare professionals.

Ultimately, virtual care (telemedicine) allows individuals to connect online anytime, anywhere with healthcare providers and other health professionals through secure text and video. A barrier to this approach is the shortage and the cost of highly trained professionals, which may have to be supplanted partially by a combination of AI and online health self-management, including prevention and treatment of chronic disease among older adults and the elderly.

Biography

Norm Archer, PhD (Physics), is *professor emeritus* of the DeGroote School of Business, McMaster University. He teaches courses in electronic health (eHealth) and information systems and has published widely on eGovernment, eBusiness, and eHealth; more specifically, Professor Archer and his students conduct research on eHealth applications and systems; eBusiness; identity theft; supply chain management; project management; change management in eGovernment; and mobile commerce. He has a major responsibility in the collaborative MSc eHealth program that is a joint undertaking by the DeGroote School of Business, Faculty of Health Sciences, and the Computing and Software Department in the Faculty of Engineering.

Preface

Adaptive Health Management Information Systems: Concepts, Cases, and Practical Applications, Fourth Edition is finally here to aid students and instructors who want to take the next big leap in digital healthcare transformation. Indeed, just as with previous editions, this new edition is not simply an update, but a complete makeover—clearly a reorganized, expanded, and fully revised manuscript with new and logically ordered contributions, still divided into the five common major themes connecting a 15-chapter series, supplemented with Technology and Policy Reviews as well as Cases and Mini-Cases. Several short, medium, and long cases are therefore assembled to promote a wide range of class discussions from the readings and beyond. Put simply, significant updates and complete revisions to all parts of the previous edition have been generated throughout the text so that readers of previous editions would not have recognized this work as a derivative of the other. It is no longer just a new hybrid vehicle that the co-editors have decided to usher in this time; instead, what we got is a "self-driving" vehicle that does away with most, if not all, of the parts powering the old model design that is driver-dependent.

As we begin to witness the power of big health data analytics, geospatial data analytics, and social media analytics, we become more conscious of how the massive data around and about us are changing our behaviors—the way we think, the way we work, and the way we interact with each other. The jobs that we currently do in the ever-growing healthcare systems are gradually fading away, as new roles are defined with advances in technological interventions and ubiquitous computing. To this end, it is hoped that this newly minted HMIS text will continue to motivate its readers to seek new perspectives, bringing together state-of-the-art knowledge as well as best practices that incorporate the benefits of emerging and innovative technologies discussed throughout this text. As evidenced both in the Contents and the range of shorter and longer cases provided in this text, the ever-growing spectrum of topics to be covered in a health information systems/information technology (health IT/IS) or health informatics courses is expanding. In this new edition, we have attempted to aggregate the different theories, methodologies, and practices into a five-part cluster that readers would be familiar with from previous editions.

Part I, comprising Chapters 1–3 (supplemented with a *Mini-case*, a *Technology Review,* as well as a *Policy Review*), offers emergent perspectives on HMIS. Part II, covering Chapters 4–7 (accompanied by two *Technology Reviews*), concentrates on HMIS technology and applications, whereas Part III, covering Chapters 8–11 (supplemented by a *Policy Review* and a *Mini-case*), shifts focus to HMIS planning and management. Part IV, which encompasses Chapters 12–15, addresses HMIS standards, governance, policy, globalization, and future, and is also supplemented with a *Policy Review* and a *Mini-case*. Finally, a range of shorter and longer cases highlighting HMIS practices and implementation are presented in Part V. Each of these major themes progressively flows from one topic to another to unveil diverse and critical aspects of the hidden HMIS gem.

It is the hope of the editorial team members that this *Fourth Edition* will open eyes, stimulate conversations, and further extend the possibilities and opportunities of future theorists, methodologists, and practitioners in the HMIS, health IT/IS, and health informatics areas.

Joseph Tan with Philip Olla (& Joshia Tan)

About the Editors

Joseph Tan

Primary author and editor, Joseph Tan, PhD (MIS), MS (Industrial and Management Engineering), BA (Maths/Computer Science), Dip (Civil Engineering), formerly *Wayne C Fox Chair* of eBusiness Innovation, is Professor of eHealth Innovation, eBusiness Strategies, Entrepreneurship & Informatics, DeGroote School of Business, McMaster University. He is the founding and ongoing Editor-in-Chief (EIC), *International Journal of Healthcare Information Systems and Informatics* (*IJHISI*), as well as the co-EIC, *International Journal of Applied Research on Public Health Management* (*IJARPHM*), with a professional background that spans a broad spectrum of interdisciplinary, multidisciplinary, and trans-disciplinary research areas. He is also EIC, *SpringerBriefs for Healthcare Economics & Management*, and the Senior Associate Editor (eHealth Informatics) of *HLPT: Health Technology & Policy*.

Joseph Tan's 30-year academic and administrative experiences include employment in academia and private and non-profit sector organizations, as well as consulting and program development activities catering to executives and foreign delegation. His management philosophy is to motivate others to work collaboratively on available opportunities (and challenges) so as to effect transformative change; he regularly mentors junior faculty, staff, and adult students. He has been named among the Top 10 most influential professors of informatics with an overall career focus to reshape the landscape of IS/IT applications and promotion in eBusiness/eHealth informatics through cross-disciplinary thinking/project partnering with diverse practitioners, clinicians, researchers, and a variety of user communities. His leadership style is to influence and inspire others to become self-made leaders, continually achieving higher quality, effective, productive, and respectful contributions in terms of realizing the shared vision and negotiated goals.

Professor Tan has published over 150 papers, abstracts, books and book chapters, editorials, and reviews. His work has appeared in over 30 refereed journals, including *AJHP; Applied Ergonomics; CMI; Computer Graphics Forum; Comm. of the ICISA; CACM; CAIS; Decision Sciences; Encyclopedia of IS; HSMR; HCMF; HCMR; H&HSA; HLPT, Hospital Topics; ISR; Inf. Res.; IJHTM; IJEH; IJHCI; IJMC; IJMTP; IJT&LD; JAMIA; JCIS; Journal of Digital Imaging; JHAE; JHCQ; JMS; Methods of Information in Medicine*; *Nature, Neural Computing & Applications,* and *THIM*, as well as numerous local, national, and international conference proceedings. Just as with time spent on compiling this revised fourth edition, Professor Tan is currently compiling a new *case text* to bring together insights and lessons learned from various sources during his many years of teaching and learning in the *Connected Health* discipline, including *eBusiness strategies, entrepreneurship, and innovation* areas. Again, this work will be collaborated with other authors, co-editors, and contributors. Another key work being planned is the *Road to Heaven on Earth*, to be released in the coming future.

Dr. Tan has demonstrated skills and ability to serve in both academia and for-profit and non-profit industry. He has achieved

recognized scholarship in teaching and learning with students' nominations for teaching excellence awards. Dr. Tan also appears as an invited keynote speaker for a number of local as well as major national and international conferences across North America, Asia, Africa, and elsewhere, and networks widely with key decision executives and policymakers apart from academic scholars and practitioners at local, provincial/state, national, and international levels, including private, public, and nongovernmental organizations and universities. As a well-established educator and negotiator, he has continued to play an active leadership role in curriculum and program accreditation, peer-reviewed journal publications, encyclopedia works and book reviews, online education and programming, planning and organization of symposiums and conferences, development of book series, special issue journals, federal grant proposals, and large-scale international interdisciplinary grant-funded programs.

Phillip Olla

Contributing author and co-editor, Dr. Phillip Olla is a Digital Health specialist with over 20 years of experience working at the leading edge of technology innovation. He is currently the CEO of Audacia Bioscience, a life science company incorporating biomarkers, AI, and smartphone technology to develop innovative diagnostic solutions. Prior to founding Audacia Bioscience, he was the Executive Director of Mobile Diagnostic Services, a social enterprise which created point-of-care diagnostic technology for low-resource global health settings. His professional experience and consulting services span an array of industries and disciplines such as Oracle, 02, Roche Diagnostics, and NASA. Dr. Olla has completed over 50 client consultancy engagements with Fortune 100 companies in 12 countries, successfully assisting with corporate education, technology deployments, business development, competitor analysis, portfolio analysis, and strategic technology roadmaps. Dr. Olla is an Adjunct Professor at the University of Windsor, and was previously the Director of Research and Professor of Health Informatics at Madonna University in Livonia, Michigan.

Dr. Olla is a public speaker who has presented extensively within the domains of industry and academia and even for nongovernmental organizations such as the World Health Organization and the United Nations. Dr. Olla has a PhD in Information Systems from Brunel University in the United Kingdom. His publications include numerous peer-reviewed journal articles, industry reports, seven book chapters, and three books; *Mobile Health Solutions for Biomedical Applications*. He is a Chartered Engineer registered with British Engineering Council and a Fellow of the Chartered Institute of Information Technology.

Joshia Tan

Editorial consultant, Joshia Tan hails from a banking and commercial background. Over the last decade or so, Joshia has held a number of leadership, strategy, sales, and commercialization roles across Brazil, Canada, China, Singapore, and the United States with HSBC—including coverage of some of the largest technology and healthcare/pharmaceutical corporates in the world. Currently, he serves as Senior Vice President of Business Development in Singapore, covering the evolving trade financing needs of Fortune 100 clients across 19 markets in the Asia Pacific region.

Joshia maintains a keen interest in the Digital Health landscape and has authored or co-authored a number of case studies and book chapters; he has also served on various advisory boards for non-profits and holds a Bachelor of Science in Business Administration from Washington University in St. Louis.