



Contents lists available at ScienceDirect

## International Journal of Forecasting

journal homepage: [www.elsevier.com/locate/ijforecast](http://www.elsevier.com/locate/ijforecast)

## Forecasting, uncertainty and risk; perspectives on clinical decision-making in preventive and curative medicine

Spyros Makridakis<sup>a,\*</sup>, Richard Kirkham<sup>b</sup>, Ann Wakefield<sup>c</sup>, Maria Papadaki<sup>d</sup>,  
Joanne Kirkham<sup>e</sup>, Lisa Long<sup>f</sup>

<sup>a</sup> University of Nicosia and Institute For the Future (IFF), 46 Makedonitissas Avenue, CY 2417, Nicosia, Cyprus

<sup>b</sup> School of Mechanical, Aerospace and Civil Engineering, Faculty of Engineering and Physical Sciences, The University of Manchester, M13 9PL, UK

<sup>c</sup> Division of Nursing, Midwifery and Social Work, Faculty of Biological Medical and Human Sciences, The University of Manchester, M13 9PL, UK

<sup>d</sup> The British University in Dubai (BUiD) and the Center for Risk and Innovation, Block 11, Dubai International Academic City, Dubai, United Arab Emirates

<sup>e</sup> St. Leonard's Hospice, Tadcaster Road, York, YO24 1GL, UK

<sup>f</sup> Kings College Hospital NHS Trust, UK

## ARTICLE INFO

## Keywords:

Uncertainty  
Risk  
Diagnostic accuracy  
Medical errors  
Preventive screening  
Medical research  
Correct treatment  
Medical reversals  
Medical predictions

## ABSTRACT

Should we screen the population routinely for the presence of breast or prostatic cancer? This simple proposition masks a landscape of complexities, including the economics of screening, the prevalence and probability of the disease, desired frequencies of intervention and a willingness to adopt preventive screening. These 'risk factors' form part of a broader landscape of uncertainty that characterises the intricacies of clinical decision-making. Deepening our understanding of the way in which clinicians evaluate risk and uncertainty requires a framing of insights into language, communication, psychology and epistemology. This paper explores perspectives in forecasting and uncertainty as a basis for understanding individuals' perceptions of risk when assessing their options in both preventative and curative medicine. At the heart of the issue is the prevalence of diagnostic error; this paper argues for the use of systematised approaches to medical error management and inclusive approaches to research in the field. The advantages of augmenting the management of unforeseen consequences through an improved understanding of the issues that are of concern to patients, carers, and medical practitioners alike forms a key construct in this paper. We conclude with an exploration of potential opportunities for improvements in medical practice: changes that may reduce the disbenefits of uncertainty and enhance the management of the general risks associated with clinical decision-making.

© 2017 The Author(s). Published by Elsevier B.V. on behalf of International Institute of Forecasters.

This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

### 1. Introduction

The diagnosis of disease and the prescription of appropriate courses of action is a decision-based problem

that is characterised by risk, uncertainty and complexity. This perspectives paper explores the 'anatomy' of clinical decision-making through the lens of complexity theory, in an attempt to understand how clinicians conceptualise a course of action through a cognitive evaluation of its benefits and disbenefits to patients. Almost all clinical decisions involve an element of forecasting; the clinician formulates

\* Corresponding author.

E-mail address: [makridakis.s@unic.ac.cy](mailto:makridakis.s@unic.ac.cy) (S. Makridakis).

<https://doi.org/10.1016/j.ijforecast.2017.11.003>

0169-2070/© 2017 The Author(s). Published by Elsevier B.V. on behalf of International Institute of Forecasters. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

hypotheses regarding the presence of a disease, the potential outcomes of a prescribed course of action, and the uncertainty and risk that are present in the decision variables. By implication, practitioners should understand the level of uncertainty that is associated with a given course of action. Equally importantly, clinicians should seek to understand how their cognitive biases and epistemological position might influence their evaluation and communication of risk when enacting clinical decisions. This paper examines the evidence related to the forecasting of risk and uncertainty within the context of clinical decision-making. We therefore make a series of evidence-based recommendations with the aim of improving the way in which risk uncertainty and complexity are communicated, including suggestions for future research.

The American College of Preventive Medicine defines the goal of medicine as being “to protect, promote, and maintain health and well-being and to prevent disease, disability, and death”.<sup>1</sup> The focus on preventative medicine in the United States (US) can be traced back to the introduction of annual generic health examinations in the early 1920s, an approach that remains the predominant instrument of preventive health today. However, various studies in the 1960s suggested that such examinations were of no clinical benefit other than to reduce patient worries (Boulware et al., 2007). This exacerbation of anxieties that may be experienced by patients undergoing routine screening has led to the emergence of the term ‘worried well’. Reinforcing this point, Glasziou, Moynihan, Richards, and Godlee (2013) argue that medicine is increasingly so pre-occupied with managing the ‘worried well’ that its resources are often stretched and unable to meet the needs of the genuinely sick. This sentiment was echoed by Krogsbøll, Jørgensen, Grønhøj Larsen, and Gøtzsche (2012), who concluded that general health checks do little to reduce morbidity or mortality, such that some national expert panels advocate that they should no longer be recommended as part of contemporary practice.

We illustrate the notion of complexity and uncertainty in relation to the management of risk in clinical decision-making by considering some of the evidence that is available to guide physicians when they are informing patients of the benefits and disbenefits of routine screening for cancer. The diagnosis of breast cancer in females and prostatic cancer in males forms the basis of the case studies presented in this paper.

### 1.1. Breast cancer screening

A frequently recommended preventive test for breast cancer is mammography. Mammography involves the use of low-dose X-rays to assist with the early diagnosis of patients who present with the symptoms of breast cancer, if no other detectable symptoms are present. From 2003 onwards, the American Cancer Society recommended annual screening for all women over 40, for as long as they remained healthy.<sup>2</sup> However, the US Preventive Service Task

Force (USPSTF) now recommends biannual mammography for women aged 50 to 74, whilst also advising women to avoid self-examinations.<sup>3</sup> Similarly, the UK recommends mammography for women over 50, as the breast is less under the influence of the menstrual hormones, and thus it is easier to establish whether a true lump exists or not. However, not only is mammography in isolation not a wholly accurate method of detecting the presence of breast cancer (Sui, 2016), it also involves a significant cost: the data suggest that in 2010, \$7.8 billion was spent on mammography tests in the US alone (O’Donoghue, Eklund, Ozanne, & Esserman, 2014).

A number of studies have sought to quantify the benefits of mammography. For example, Gøtzsche (2012) argues that mammography reduces breast cancer risk by one third, and the independent review of the literature by the Independent UK Panel on Breast Cancer Screening (2012) shows a small absolute reduction in mortality rates as a result of screening. However, Harding et al.’s (2015) study of almost 60,000 women across the US refutes Gøtzsche’s findings, instead concluding that mammograms lead to over-diagnosis. Gøtzsche (2012) also highlights the potential harms that can arise due to over-diagnosis and overtreatment.

Perhaps driven by the inconclusive nature of the debate regarding the benefits of mammography, one recent addition to the breast screening armoury is digital breast tomosynthesis (DBT), a tool which produces images that are similar in both quality and definition to CT scans (Diekmann & Bick, 2011). This relatively novel screening process is showing encouraging results, particularly in women with dense breast tissue, among whom it is especially difficult to accurately distinguish breast abnormalities using traditional or digital mammography techniques, leading to more recalls (Takahashi, Lee, & Johnson, 2017). DBT highlights genuine tumours more clearly than other screening tools, meaning that recalls and false positives are less common and patients experience better health outcomes (McDonald et al., 2016). As DBT is still in its infancy, its efficacy as a viable and reliable diagnostic option is yet to be verified. Nevertheless, McDonald et al.’s (2016) three-year study comparing digital mammography with DBT showed promising results, although both the long term impact of DBT on patient outcomes and its ability to arrest the disease trajectory need further evaluation.

### 1.2. Prostatic cancer screening

In the same way that screening tools are designed to reduce the risk of fatal breast cancer in women, the prostate-specific antigen (PSA) test is designed to reduce the number of fatal prostatic cancers in men. Up to 52% of men undergo PSA testing annually, at a cost exceeding half a billion dollars for US Medicare patients alone (Ma et al., 2014). As with breast cancer, numerous studies have presented cases for and against screening, drawing conclusions that are broadly similar to those outlined above for breast cancer. Ablin (2014) argues that PSA tests are ‘marginally more

<sup>1</sup> See <http://www.acpm.org/?page=WhatIsPM>.

<sup>2</sup> See <https://www.cancer.org/healthy/find-cancer-early/cancer-screening-guidelines/chronological-history-of-acs-recommendations.html>.

<sup>3</sup> See <http://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/breast-cancer-screening>.

متن کامل مقاله

دریافت فوری ←

**ISI**Articles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات