

# Chapter 3

## Data-Driven Approaches for Developing Clinical Practice Guidelines

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### ABSTRACT

*This chapter discusses clinical practice guidelines (CPGs) and their incorporation into healthcare IT (HIT) applications. CPGs provide guidance on treatment options based on evidence. This chapter provides a brief background on challenges in CPG development and adherence, and offers examples of data-driven approaches to improve usability of CPGs and their applications in HIT. A focus is given to clinical pathways, which translate CPG recommendations into actionable plans for patient management in community practices. Approaches for developing data-driven clinical pathways from electronic health record data are presented, including statistical, process mining, and machine learning algorithms. Further, efforts on using CPGs for decision support through visual analytics, and deployments of CPGs into mobile applications are described. Data-driven approaches can facilitate incorporation of practice-based evidence into CPG development after validation by clinical experts, potentially bridging the gap between available CPGs and changing clinical needs and workflow management.*

### INTRODUCTION

Clinical practice guidelines (CPGs) are “systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances” (Field & Lohr, 1990; Steinberg, Greenfield, Mancher, Wolman & Graham, 2011). CPGs are known as the best sources of available medical evidence, and their usage is expected to improve health outcomes, avoid unnecessary treatment variations, and reduce overall costs of care (Rotter et al., 2012; Saint, Hofer, Rose, Kaufman, & McMahon, 2003). Hence, recommendations from CPGs can play a crucial role in shaping the way

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healthcare providers care for patients. In the United States, the National Guideline Clearinghouse (NGC), maintained by the Agency for Healthcare Research and Quality (AHRQ) of the Department of Health and Human Services, is a publicly available repository of evidence-based clinical practice guidelines created by professional healthcare organizations (“Guideline Index,” 2015). For example, the National Kidney Foundation (NKF) produces CPGs through the NKF Kidney Disease Outcomes Quality Initiative (KDOQI) to provide evidence-based guidelines for the diagnosis and management of chronic kidney disease (CKD) and associated complications (Levin & Rocco, 2007). In the United Kingdom, the National Institute for Health and Care Excellence (NICE) publishes clinical, public health, social care, safe staffing and medication practice guidelines (“Find guidance,” 2014). NICE guidelines cover 23 broad clinical conditions, each of which further extends to sub-conditions (“Conditions,” 2014).

Typically, CPGs are text-based, and contain very detailed, contextualized recommendations about various clinical circumstances that may arise during the diagnosis and management of health conditions. Accessing CPGs during patient care imposes significant cognitive workload due to their length and detailed content (Zhang et al., 2015; Zhang, Padman & Patel, 2015; Zhang & Padman, 2015). As information technology (IT) gains widespread adoption in healthcare, researchers have developed languages and systems to incorporate CPGs into healthcare IT (HIT) applications with the objective of guiding more efficient healthcare practice (Peleg, 2013). This chapter summarizes the current state of CPG usage by clinicians and presents an overview of data-driven methodologies that can be incorporated into HIT systems to address some of the challenges in CPG deployment and usage. We further delve into data-driven clinical pathway learning, visual analytics, and mobile healthcare applications that are key components to facilitate the incorporation of CPGs into current best practices. Finally, we discuss CPG-based clinical decision support (CDS) that integrates these components into an effective tool for encouraging adherence and facilitating decision support at the point of care (Lobach & Hammond, 1997) to improve the quality and efficiency of modern healthcare delivery.

## **BACKGROUND**

As of 2015, the number of CPGs in the US National Guideline Clearinghouse is 2,382 (“Guideline Index,” 2015). On the other hand, the number of diagnostic codes in ICD-10 is 69,823 (“Classification,” 2015). There is a clear shortage of CPGs, given the number of clinical conditions that exist. In addition, CPGs across clinical areas contain recommendations with differing *strengths of evidence*. *Strength of evidence* is categorized into 3 levels:

1. Consistent and good quality patient-oriented evidence,
2. Inconsistent or limited quality patient oriented evidence,
3. Consensus by experts (Ebell et al., 2004).

Most clinical practice guidelines and pathways are designed with the ‘average patient’ in mind (Geleris & Boudoulas, 2011; Rosoff, 2001), and its development process is driven by evidence from randomized clinical trials (RCTs) in some areas and by consensus opinions of experts in others (Uhlig, Balk, Lau, & Levey, 2006). For instance, while recommendations made in CPGs for conditions such as hypertension are frequently based on consistent, good quality, patient-oriented evidence (“Rating,” 2014), strength of evidence in nephrology is known to be of lower quality (Uhlig et al., 2006). Even evidence from

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