



## Review article

# Determinants of the overuse of imaging in low-risk prostate cancer: A systematic review

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## Abstract

**Background:** The overuse of radiologic services, where imaging tests are provided in circumstances where the propensity for harm exceeds the propensity for benefit, comprises a risk to patient safety and a burden on health care systems. Advanced imaging in the staging of low-risk prostate cancer is considered an overused procedure by many professional societies, yet the determinants that drive this phenomenon are not fully appreciated.

**Methods:** We systematically searched published literature within MEDLINE and Embase from January 1998 to March 2017. We searched for studies conducted in the United States that contain original data and describe determinants associated with the overuse of imaging in low-risk prostate cancer. Paired reviewers independently screened abstracts, assessed quality, and extracted data. We synthesized the identified determinants as patient-level, clinician-level, or system-level factors of overuse.

**Results:** A total of 14 articles were included; the 13 empirical studies defined overuse as being the use of imaging that was discordant with clinical guidelines. Patient- and system-related factors were most commonly described as being associated with overuse; clinician-level determinants were examined infrequently. Older patient age ( $n = 5$ ), more patient comorbidities ( $n = 7$ ), and characteristics related to geography ( $n = 6$ ), higher regional income ( $n = 6$ ), and less education ( $n = 5$ ) were the most consistently identified statistically significant determinants of overuse. Meaningful differences were detected between health care settings; large integrated health care systems provided less variable care and had lower rates of overuse. Clinical indicators related to prostate cancer were inconsistently associated with overuse.

**Conclusion:** Many patient- and system-related determinants were identified as contributing to the overuse of advanced imaging to stage low-risk prostate cancer. Overuse may be the consequence of systematized clinician behavior and be relatively invariant of patient characteristics. The identified system-level determinants suggest that payment models that are not tied to volume or that reward, enhanced care co-ordination may curb overuse. We propose further examination of physician-level determinants and implore researchers to rank the relative importance of the identified factors and to test their influence through experimental and quasi-experimental methods. © 2017 Elsevier Inc. All rights reserved.

**Keywords:** Overuse; Imaging; Prostate cancer; Quality measurement; Health care costs

## 1. Introduction

Many health outcomes in the United States lag behind those of other developed nations [1–5]. The prevailing

explanation is that the overuse of health care services in the United States harms patients, raises the cost of care, and diverts funding from necessary and beneficial services [4]. Among the health care services with widespread overuse is radiologic imaging [6]. From 1996 to 2010 imaging use increased significantly across all types of health systems [7].

Several professional societies and policy organization have released guidelines and developed quality measures that aim to reduce the use of diagnostic imaging in diverse

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patient populations and care settings. Both the American Society of Clinical Oncology and the American Urological Association have listed the reduction of inappropriate imaging in men with prostate cancer as a priority and included this in their recommendations for the *Choosing Wisely* initiative of the American Board of Internal Medicine [8–10]. Although the literature on the overuse of imaging services has focused mostly on describing the prevalence of use of these services [11], more recent scholarship has sought to learn what drives or determines overuse in this clinical setting. Why does imaging in men with early stage prostate cancer remain so prevalent? We aimed to synthesize the primary empirical literature describing the determinants of, or factors demonstrated to be associated positively or negatively with, the overuse of imaging in men with low-risk prostate cancer.

## 2. Materials and methods

### 2.1. Data sources and searches

We searched MEDLINE and Embase from January 1998 through March 2017 for English literature, of any study design. Our search broadly included terms reflecting overuse of imaging for low-risk prostate cancer: Low-risk prostate cancer: prostate [MeSH Terms] OR prostate [tiab] OR prostatic neoplasms [mesh] OR ((MUSIC [tiab] OR benign\*[tiab] OR malign\*[tiab] OR neoplasm\*[tiab] OR carcinoma\*[tiab] OR cancer\*[tiab] OR tumor[tiab] OR tumors[tiab] OR tumoral\*[tiab] OR tumori\*[tiab] OR tumorlet\*[tiab] OR tumour\*[tiab] OR polyp [tiab] OR polyps [tiab] OR polypu\*[tiab] OR polypi [tiab] OR adenom\*[tiab]) AND prostat\*[tiab]) AND “early stage” [ti] OR staging[ti] OR “low grade”[ti] OR “low risk”[ti]; with Overuse: “unnecessary procedures” [mh] OR overuse [tiab] OR inappropriate[ti] OR unnecessary[ti] OR “health services misuse” [MeSH Terms]

We handsearched the reference lists of each included article as well as related systematic reviews for additional articles. The protocol was registered in Prospero (#42015029482).

### 2.2. Study selection

A total of 2 reviewers independently screened titles, abstracts, and full-text for inclusion. Differences between investigators were resolved through consensus adjudication. We included original, English-language studies, that were not exclusively describing populations of patients or clinicians outside of the United States. We further restricted the study to data collected after 1996 given the substantial changes in the US health care system in the past 2 decades. We had no restrictions regarding study design.

### 2.3. Data extraction, quality, and applicability assessment

We created standardized forms for data extraction and pilot tested the forms before beginning the process of data extraction. Reviewers extracted information on the general study characteristics, study participant characteristics, the methods of data collection, the overuse event under investigation, the determinants evaluated and the determinants identified as significantly associated with the overuse event. We used the criteria for statistical significance as defined by each study. The determinants were classified during data abstraction as being related to the patient, the clinician, or the environment. One reviewer completed data abstraction and the second reviewer confirmed the first reviewer's data abstraction for completeness and accuracy.

Two reviewers independently assessed the risk of bias in included studies. The critical appraisal checklist (from the center for evidence-based management) was used for cohort studies and surveys [12]. The single qualitative study was assessed using the tool from the Joanna Briggs Institute [13].

### 2.4. Data synthesis and analysis

We created a set of detailed evidence tables. We synthesized the results by determinants organized as patient-level, clinician-level, and environmental or systems level. The data were not amenable to quantitative pooling given the nature of the data and the heterogeneity across studies.

### 2.5. Role of the funding source

The funders had no role in this project.

## 3. Results

We identified 1920 titles meeting our inclusion criteria. From these, we identified 47 articles for full-text review. A total of 14 studies examined the determinants of imaging overuse in the staging of low-risk prostate cancer (Fig.).

### 3.1. Characteristics of included studies

Among the included studies were 13 cross-sectional studies [14–26] and 1 qualitative survey that used semi-structured interviews [27] (Table 1). Nine studies used Surveillance, Epidemiology, and End Results-Medicare linked data [15,18–23,25,26], 4 studies used data from the Veterans Health Administration [14,21,24,27], and 2 studies used data from a single institution or system [16,17].

All of the included empirical studies defined overuse as being the use of imaging that was discordant with clinical guidelines regarding the initial evaluation of patients with

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