Medical Care Research and Review
70(5) 451–472

DOI: 10.1177/1077558713496166
mcr.sagepub.com
SAGE

A Conceptual Framework for Understanding and Reducing Overuse by Primary Care Providers

Adam A. Powell[1,2], Hanna E. Bloomfield[1,2], Diana J. Burgess[1,2], Timothy J. Wilt[1,2], and Melissa R. Partin[1,2]

Abstract

Primary care providers frequently recommend, administer, or prescribe health care services that are unlikely to benefit their patients. Yet little is known about how to reduce provider overuse behavior. In the absence of a theoretically grounded causal framework, it is difficult to predict the contexts under which different types of interventions to reduce provider overuse will succeed and under which they will fail. In this article, we present a framework based on the theory of planned behavior that is designed to guide overuse research and intervention development. We describe categories of primary care provider beliefs that lead to the formation of intentions to assess the appropriateness of services, and propose factors that may affect whether the presence of assessment intentions results in an appropriate recommendation. Interventions that have been commonly used to address provider overuse behavior are reviewed within the context of the framework.

Keywords

overuse, inappropriate care, theory of planned behavior, theory of reasoned action, physician decision making

This article, submitted to *Medical Care Research and Review* on January 11, 2013, was revised and accepted for publication on June 11, 2013.

[1]Center for Chronic Disease Outcomes Research, Minneapolis VA Health Care System, Minneapolis, MN, USA
[2]Department of Medicine, University of Minnesota, Minneapolis, MN, USA

Corresponding Author:
Adam A. Powell, Minneapolis VA Health Care System, One Veterans Drive (111-0), Minneapolis, MN 55417, USA.
Email: adam.powell@va.gov

Overuse in primary care is prevalent, costly, and harmful (Delaune & Everett, 2008; Korenstein, Falk, Howell, Bishop, & Keyhani, 2012). In recent years, this issue has received greater attention from scholars (e.g., see *Archives of Internal Medicine*'s "Less Is More" series), provider organizations (Good Stewardship Working Group, 2011), and policy and advocacy groups (e.g., National Priorities Partnership). Many practitioners and patients are aware that change is needed (How, Shih, Lau, & Schoen, 2008; Sirovich, Woloshin, & Schwartz, 2011). Yet we know surprisingly little about how to reduce overuse. In this article, we present a conceptual framework that specifies causal antecedents to inappropriate primary care provider (PCP) recommendations that lead to overuse. This framework is designed to help researchers, practitioners, and administrators identify potentially modifiable antecedents of overuse and to guide the development of interventions to reduce overuse while maintaining high levels of appropriate use.

New Contributions

Although a number of theoretical frameworks have been proposed to describe and predict provider behavior (e.g., Eccles, Grimshaw, Walker, Johnston, & Pitts, 2004; Michie et al., 2005), these frameworks have been designed primarily to address underuse and have therefore focused on the final step—provision of a service. To better understand PCP overuse, the focal behavior in our proposed model is the assessment of appropriateness of a service. By specifying causal antecedents to appropriate assessment behaviors and the types of interventions that can be employed to affect each antecedent, the proposed framework provides new guidance to researchers, practitioners, payers, and policy makers.

Definition of Overuse

We define overuse as *the provision of a service whose expected net benefit (benefits minus negative consequences) is less than the expected net benefit of either providing a different service or not* intervening at all. (Other similar definitions of overuse are provided by Chassin & Galvin, 1998; Kahn et al., 1988; and Owens, Qaseem, Chou, & Shekelle, 2011). Examples of overuse include the provision of services

- that are not clinically indicated for the patient's symptom or diagnosis (e.g., imaging studies for lower back pain),
- when the patient's life expectancy is too short to realize the eventual benefit of a service (e.g., abdominal aortic aneurysm screening among patients with less than 5-year life expectancy),
- that are not matched to the patient's risk of disease (e.g., electrocardiography for the prediction of coronary heart disease in low-risk patients),
- that occur too frequently (e.g., annual vs. less frequent Pap smear testing for cervical cancer screening), or

- when the patient has contraindications that increase the risk associated with the service or follow-up procedures (e.g., cancer screening or diagnostic colonoscopy among patients who have severe comorbidities).

As these examples illustrate, an appropriate PCP recommendation depends not only on knowledge of clinical evidence but also on knowledge of the patient's demographic and clinical characteristics, personal and family health history, testing history, and/or tolerance level for downstream follow-up procedures.

Scope of the Problem

Overuse is a major contributor to the unsustainably high cost of health care. It has been estimated that approximately 30% of all health care expenditures in the United States are for inappropriate services (Delaune & Everett, 2008). However, there are also important nonmonetary costs. Overuse of services exposes patients to unnecessary health risks, incurs unnecessary costs, and may divert resources away from more effective forms of care.

Estimates of overuse in primary care vary dramatically depending on the definition of overuse and the service in question. In a recent systematic review, Korenstein et al. (2012) report overuse rates of 2% to 89% for antibiotics, 16% to 80% for prostate cancer screening, 5% to 28% for imaging for lower back pain, and 23% to 61% for colonoscopy. Nearly half of U.S. PCPs believe that patients receive too much care, and 28% report that they themselves practice too aggressively (Sirovich et al., 2011). One third of U.S. adults believe that they have received medical care that was unnecessary (How et al., 2008), and 19% indicate that they have had providers order duplicate medical tests (The Commonwealth Fund, 2011).

Conceptual Framework

Our framework specifies a number of cognitive and behavioral antecedents that can lead to PCP overuse of interventions (see Figure 1). A primary objective in developing this framework was to provide a structure that can be used to identify barriers to appropriate use of services, and to provide guidance on developing interventions to address barriers once they are identified. Therefore, in addition to specifying antecedents to overuse, we review the most commonly used interventions to change PCP behavior and describe how these interventions may affect antecedents of overuse.

Interventions were identified by searching the Medline database for English language articles on adult populations published between 1996 and 2011 in which the abstracts or titles contained one or more of the following terms: *unnecessary, overuse, overutilization, inappropriate*, or *polypharmacy* and the term *intervention* or *trial*. We manually searched the abstracts of the resulting articles to identify randomized or nonrandomized controlled trials that (a) included a control condition, (b) reported a measure of overuse as a dependent variable, and (c) focused primarily or exclusively on changing PCP behavior. We searched for additional interventions by reviewing

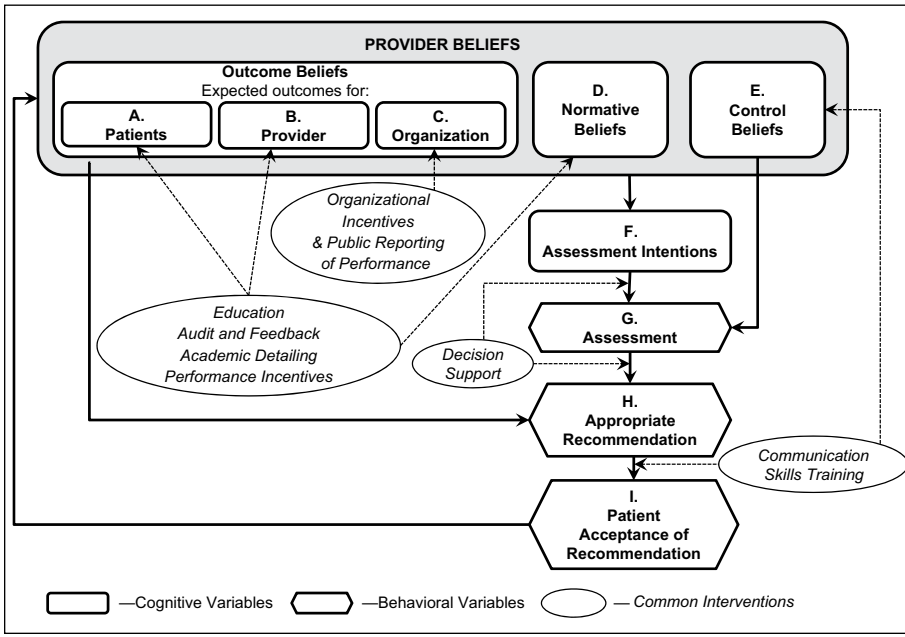

Figure 1. Theoretical framework to understand appropriateness of primary care provider service recommendations.

articles that either cited or were cited by the articles appearing in our initial search. A total of 35 interventions were identified. Table 1 documents key information on each intervention categorized by intervention type. To address gaps in the overuse literature, we also selectively draw on interventions to reduce underuse in the description of the proposed framework.

Our framework is based on the theory of planned behavior (TPB) and incorporates other theories of motivation and goal setting to adapt the TPB to the context of overuse. The TPB was developed in the mid-1980s as a framework to understand relationships between cognitions and behavior and has become one of the most widely cited theories in social psychology (Ajzen, 2011). Meta-analyses indicate that variables specified in the TPB account for most of the variation in behavior once random measurement error is accounted for (Ajzen, 2011).

The TPB proposes that the most proximal determinant of behavior is an *intention or behavioral plan* that enables the attainment of a goal. Intentions, in turn, are a function of beliefs about outcomes, norms, and behavioral control (Ajzen, 1991). This proposition has been supported in numerous studies on provider behavior (see Godin, Belanger-Gravel, Eccles, & Grimshaw, 2008, for a review), including studies of overuse among PCPs (e.g., Eccles et al., 2007; Ramsay, Thomas, Croal, Grimshaw, & Eccles, 2010).

Table 1. Published Interventions to Reduce Overuse of Services by Primary Care Providers.

Study	Country	Design	Intervention Type	Clinical Domain	RRR
Eccles et al. (2001)	United Kingdom	RCT: Pre–post	Provider education	Imaging	+27%
Freeborn, Shye, Mullooly, Eraker, and Romeo (1997)	United States	NCT: Pre–post	Provider education	Imaging	*ns*
Hennessy et al. (2002)	United States	NCT: Pre–post	Provider education	Antibiotics	+24%
Hickman, Stebbins, Hanak, and Guglielmo (2003)	United States	NCT: Pre–post	Provider education	Antibiotics	+31%
Juzych, Banerjee, Essenmacher, and Lerner (2005)	United States	NCT: Pre–post	Provider education	Antibiotics	+20%
McNulty et al. (2000)	United Kingdom	NCT: Pre–post	Provider education	Antibiotics (broad spectrum)	+24%
McNulty et al. (2000)	United Kingdom	NCT: Pre–post	Provider education	Antibiotics (overall use)	*ns*
Meyer, Summers, and Moller (2001)	South Africa	RCT: Pre–post	Provider education	Antibiotics	+46%
Freeborn et al. (1997)	United States	NCT: Pre–post	Provider education audit and feedback	Imaging	*ns*
Pimlott et al. (2003)	Canada	RCT: Pre–Post	Provider education audit and feedback	Perscribing; benzodiazepine	+9%
Schectman, Schroth, Verme, and Voss (2003)	United States	RCT: Pre–post	Provider education audit and feedback	Imaging; physical therapy	+47%
Welschen, Kuyvenhoven, Hoes, and Verheij (2004)	Netherlands	RCT: Pre–post	Provider education audit and feedback Communication skills training	Antibiotics	+32%
Gonzales, Steiner, Lum, and Barrett (1999)	United States	NCT: Pre–post	Provider education audit and feedback Academic detailing	Antibiotics	+22%
Baker, Falconer Smith, and Lambert (2003)	United Kingdom	RCT: Pre–post	Audit and feedback	Lab tests (thyroid function, rheumatoid factor, urine culture)	*ns*
Baker et al. (2003)	United Kingdom	RCT: Pre–post	Audit and feedback	Lab tests (serum lipids and viscosity)	*ns*
Blais, Laurier, and Pare (2008)	Canada	RCT: Pre–post	Audit and feedback	Prescribing, beta-agonists	*ns*
Bunting and van Walraven (2004)	Canada	RCT: Pre–post	Audit and feedback	Lab tests	+8%
Eccles et al. (2001)	United Kingdom	RCT: Pre–post	Audit and feedback	Imaging	*ns*
Melander, Björgell, Björgell, Ovhed, and Mölstad (1999)	Sweden	NCT: Pre–post	Audit and feedback	Antibiotics	+10%

(continued)

Table 1. (continued)

Study	Country	Design	Intervention Type	Clinical Domain	RRR
O'Connell, Henry, and Tomlins (1999)	Australia	RCT: Pre–post	Audit and feedback	Prescribing	*ns*
Verstappen et al. (2003)	Netherlands	RCT: Pre–post	Audit and feedback	Tests for upper abdominal complaints	+24%
Verstappen et al. (2003)	Netherlands	RCT: Pre–post	Audit and feedback	Tests for fatigue or joint complaints	*ns*
Allard, Hebert, Rioux, Asselin, and Voyer (2001)	Canada	RCT: Pre–post	Audit and feedback (pharmacist led)	Polypharmacy	*ns*
Hanlon et al. (1996)	United States	RCT: Pre–post	Audit and feedback (pharmacist led)	Polypharmacy	+24%
Krska et al. (2001)	Scotland	RCT: Post only	Audit and feedback (pharmacist led)	Polypharmacy	+65%
Zwar, Wolk, Gordon, Sanson-Fisher, and Kehoe (1999)	United Kingdom	RCT: Pre–post	Audit and feedback Academic detailing	Antibiotics	*ns*
Coenen, Van Royen, Michiels, and Denekens (2004)	Belgium	RCT: Pre–post	Academic detailing	Antibiotics	+23%
Simon et al. (2006)	United States	RCT: Pre–post	Academic detailing	Prescribing	*ns*
Briel et al. (2006)	Switzerland	RCT: Post only	Communication skills training	Antibiotics	*ns*
Bates et al. (1999)	United States	RCT: Post only	Decision support	Lab tests	+47%
McIsaac and Goel (1998)	Canada	RCT: Post only	Decision support	Antibiotics	+22%
McIsaac, Goel, To, Permaul, and Low (2002)	Canada	RCT: Pre–post	Decision support	Antibiotics	*ns*
Rossi and Every (1997)	United States	RCT: Post only	Decision support	Prescribing, general	+11%
Samore et al. (2005)	United States	RCT: Pre–post	Decision support	Antibiotics	+11%
Tamblyn et al. (2003)	Canada	RCT: Post only	Decision support	Prescribing, general	+16%

Note: RCT = randomized controlled trial; NCT = nonrandomized controlled trial; RRR = relative risk reduction; *ns* = not significant at $p < .05$.

Most TPB analyses of provider behavior focus on utilization rates (e.g., prescribing rates, cancer screening rates). However, as we are concerned with minimizing overuse through *appropriate* utilization, our framework focuses on the *adequate assessment of the appropriateness* of a service (Figure 1, Box F). We focus on adequate assessments of appropriateness because, for commonly overused services, it is unlikely that appropriate utilization of services will consistently occur if PCPs lack the time, motivation,

or knowledge to match patient-specific information such as the patient's symptoms and health history with information on the appropriate indications of a service. Unless an adequate assessment is done, PCPs may simply recommend a service to all patients who meet a small number of easily identified criteria (e.g., gender or age). For example, studies suggest that although providers usually take age into account when considering cancer screening tests, they often fail to incorporate information on patient comorbidities into their decisions (Bynum, Braunstein, Sharkey, Haddad, & Wu, 2005; Walter et al., 2009).

Assessment intentions are not dichotomous variables but are instead "plans of action." These action plans may include intentions about what forms of information to consider and how to obtain this information. Although some form of appropriateness assessment typically occurs prior to the provision of a service, contextual features of the clinical encounter (e.g., lack of time) may create barriers to carrying out this assessment in the intended manner, particularly for nonacute issues. For example, after attending an educational presentation on overuse of imaging studies, a provider may form an intention to order an MRI (magnetic resonance imaging) for low back pain only when there is an evidence-based indication for the test. Yet when a patient arrives 20 minutes late for her appointment and requests an MRI to evaluate her chronic low back pain, the provider may feel that it is easier to order the test than to take the time to determine if it is really indicated in this particular patient and, if it is not, to explain to the patient why an MRI is not being ordered. Thus, provider interventions to reduce overuse that are delivered outside of the clinic may be effective at creating assessment intentions, yet they may not have the desired effect on assessment behavior because contextual aspects of the clinic visit can break the intention–behavior link. Conversely, interventions that occur in the context of the clinical encounter (e.g., electronic decision aids) may be ineffective if they conflict with the provider's preferred strategy for assessing appropriateness (assessment intentions).

The TPB proposes that an intention is a function of beliefs about outcomes, norms, and behavioral control (Figure 1, Boxes A-E). For our analysis, we have further separated outcome beliefs into three general categories. Borrowing from Batson, Ahmad, and Tsang's (2002) description of three motivations underlying helping behavior (altruism, egoism, and collectivism), we distinguish between (a) outcomes for patients, (b) outcomes for the self, and (c) outcomes for the organization. We propose that PCP interventions to reduce overuse are successful to the extent that they either affect these beliefs or affect providers' ability to reach a correct conclusion when an assessment of appropriateness is undertaken (Figure 1, Box G).

Expected Outcomes for Patients (Box A)

Beliefs about patient outcomes specify expected benefits and harms for patient subgroups. Beliefs about *clinical patient outcomes* may stem from knowledge of empirical evidence, personal experience, or anecdotal evidence relayed by others. The advanced training of PCPs does not exempt them from similar heuristics and biases that have been demonstrated to influence the public at large. For example, an

overgeneralization of a "screening is good" heuristic may explain why one quarter of surveyed PCPs believed that lung cancer screening was guideline concordant when no such guidelines existed (Klabunde et al., 2012). Beliefs about *nonclinical patient outcomes*, such as anxiety, or the patient's desire for active management may also play a role in PCP decisions about the appropriateness of a service (Balague & Cedraschi, 2006).

Interventions Affecting Beliefs About Outcomes for Patients. The most common intervention strategy among the overuse intervention studies we reviewed was *provider education on clinical evidence or guidelines.* Interventions that rely solely on provider education have found inconsistent benefits, with relative risk reductions (RRRs) in overused services ranging from nonsignificant (*ns*) to 46% (Table 1). *Audit and feedback* is a form of provider education that affects intentions by providing information about the appropriateness of one's prior service utilization and is therefore likely to affect PCP beliefs about which patients can be expected to benefit from a service. As with other forms of provider education, audit and feedback interventions have a mixed record of success in reducing overuse (RRRs from *ns* to 65%).

Expected Outcomes for the Self (Box B)

For some services, indiscriminate use may be associated with positive outcomes for the provider even if patient outcomes are negative. Ransohoff, McNaughton, and Fowler (2002) describe how PCPs often experience positive personal outcomes for providing prostate cancer screening regardless of the test's appropriateness or outcome. If test results are normal, providers enjoy delivering good news. If results are abnormal, the provider experiences a sense of value by offering critical advice. If a test is found to be a false positive, the provider can share in relief with the patient; and if cancer is found, the patient is likely to express gratitude that their provider's actions led to the detection of the disease.

Work from social and organizational psychology suggests that the hierarchical nature of the provider–patient relationship may lead PCPs to prioritize their own outcomes over patient outcomes (Overbeck & Park, 2006). Indeed, several studies have documented that provider beliefs about how service utilization affects their own welfare can result in overuse. These beliefs include concerns about litigation (Sirovich et al., 2011), the time and effort required to educate patients on the risks of a procedure (Bendtsen, Hensing, McKenzie, & Stridsman, 1999; Srisurapanont, Garner, Critchley, & Wongpakaran, 2005), and a desire to obtain financial incentives (Zhang, Lee, & Donohue, 2010).

To the extent that PCP performance evaluations and pay are determined by patient compliance rates, providers may feel that conducting individual assessments of the appropriateness of incentivized services will carry with it negative personal consequences. Although measures such as cancer screening or immunization rates often exclude some categories of inappropriate patients, in the absence of parallel measures that discourage overuse, PCPs may feel that erring on the side of overuse is the best

way to ensure that they are credited for every patient included in measures used to calculate incentives.

Interventions Affecting Beliefs About Outcomes for the Self. In addition to affecting beliefs about patient outcomes, *audit and feedback* interventions may also affect beliefs about outcomes for the provider. Obtaining regular feedback on their rates of service overuse may lead PCPs to establish improvement goals. Providers may expect to experience self-rewarding emotions such as pride on receiving documentation of improvement. Conversely, providers may expect to experience guilt or embarrassment if feedback indicates a failure to improve. A useful addition to future evaluations of audit and feedback interventions would be an assessment of the extent to which positive intervention effects are mediated by improved clinical knowledge about appropriate use, increased motivation to achieve high scores, or both.

We found only one study that employed *PCP incentives* to reduce overuse. The intervention was designed to reduce antibiotic use and included provider monetary incentives as well as provider and patient education components (Flottorp, Oxman, Håvelsrud, Treweek, & Herrin, 2002; excluded from Table 1 because the effect of the provider and patient components of the intervention could not be disentangled). In spite of the multifaceted approach, the intervention effects were modest (3% reduction in use of antibiotics for sore throat, no significant reduction in use for urinary tract infections). Reviews of the use of incentives to reduce underutilization of primary care services indicate insignificant to small positive effects (Campbell, Reeves, Kontopantelis, Sibbald, & Roland, 2009; Gavagan et al., 2010).

Expected Outcomes for the Provider's Organization (Box C)

PCPs who have a positive image of their organization may adopt the organization as an important part of their social identity (Dukerich, Golden, & Shortell, 2002; Turner, 1999). As a result, they may prioritize efforts that benefit the organization even if they receive no personal benefit. The formation of organizational identity can occur at the facility, clinic, or work team level (Johnson, Morgeson, Ilgen, Meyer, & Lloyd, 2006). Just as individual incentives can inadvertently promote overuse, group-level incentives can have a similar effect on PCPs who identify at the group level. Thus, even when PCPs are not individually recognized or compensated for usage rates, if their facility, clinic, or team receives recognition for high performance scores, providers may be motivated to offer services indiscriminately.

Interventions Affecting Beliefs About Outcomes for the PCP's Organization. *Organizational incentives* may be the most common way of influencing beliefs about outcomes for the provider's organization. However, a review on the use of incentives in a variety of health care domains suggests that compared to interventions using provider-directed incentives, the effects of organization-level incentives are small (Van Herck et al., 2010). *Public reporting of performance scores* may also affect beliefs about outcomes for the organization. Public reporting can affect financial outcomes through the gain or

loss of patients and can instill a sense of either group pride or embarrassment. A review of the literature on publically reporting health care performance (primarily focused on underuse measures) found small and inconsistent effects (Fung, Lim, Mattke, Damberg, & Shekelle, 2008). We know of no health care studies on organizational incentives or public reporting of performance scores that focused on rates of overuse.

Normative Beliefs (Box D)

Physicians do not practice in a vacuum. According to the TPB, perceptions about colleagues and administrative leaders' beliefs and values about primary care services can influence behavioral intentions independent of beliefs about the outcomes of behavior. There are two types of normative beliefs. *Prescriptive* norms—beliefs about what others feel one should do (Cialdini, Reno, & Kallgren, 1990)—provide information on what behavior is considered appropriate among one's clinical colleagues and organizational leadership. Prescriptive norms affect behavioral intentions only to the extent that the beliefs of others in the social environment are considered important (Ajzen, 1991). *Descriptive norms* are perceptions of the actual behavior of one's colleagues (Cialdini et al., 1990). Although descriptive norms can at times contradict prescriptive norms, they can still affect behavioral intentions because they provide insight into what techniques may be most efficient and practical in the imperfect environment of the clinic. Thus, to determine if normative beliefs affect PCP overuse, it is necessary to identify (a) which individuals or groups influence provider attitudes, (b) provider perceptions about what these influential others believe is appropriate behavior, and (c) perceptions about what influential others actually do.

Interventions to Affect Normative Beliefs. *Educational interventions* may be augmented to increase their influence on normative beliefs. If PCPs believe overprescribing to be the norm among their peers, then *delivery of information by peers or opinion leaders* may be able to address this barrier. Academic detailing interventions that involve one-on-one educational meetings with clinicians are often delivered by specialists with unique content expertise. Although one might expect these interventions to change beliefs about descriptive or prescriptive norms and thus reduce overuse, effects of academic detailing interventions on overuse have been modest (RRRs from *ns* to 23%).

Audit and feedback interventions may be more likely to affect normative beliefs if the feedback is provided by recognized experts. Interventions to reduce polypharmacy often utilize pharmacists to deliver individual feedback to PCPs regarding the appropriateness of drug regimens. Of the intervention that relied primarily or exclusively on audit and feedback, two studies with the largest positive effect utilized pharmacists to provide feedback (Hanlon et al., 1996; Krska et al., 2001). Although the use of individuals with specialized training to monitor overuse may be promising, it is also resource intensive. Additionally, if these experts are expected to guide PCPs toward more appropriate usage habits, it is critical that they are not themselves biased toward overuse. Specialists have been found to order more tests and be are more likely to overtreat than PCPs (Phillips & Bazemore, 2010).

One intervention designed to reduce overuse of imaging tests in primary care included *information on the practice patterns of colleagues* along with individualized audit and feedback (Eccles et al., 2001). Based on our framework, we would hypothesize that this information would affect descriptive norms. The intervention did not, however, reduce radiology referral rates. It is possible that normative feedback about the performance of colleagues not only raises the standard of expectation for clinicians on the low end of the distribution but also lowers the standard for the high performers, resulting in no aggregate change in performance. This hypothesis is consistent with two meta-analyses of audit and feedback interventions that found that including feedback on the performance of colleagues does not provide additional benefit over providing feedback only on one's own performance (Hysong, 2009; Kluger & DeNisi, 1996).

Control Beliefs (Box E)

Control beliefs represent expectations about one's ability to successfully carry out a desired behavior. If PCPs feel that they will be unable to successfully carry out an adequate assessment of a service's appropriateness under typical practice conditions, they are unlikely to form intentions to do so.

Organizational policies and communications can create a climate in which employees feel more or less behavioral control or *autonomy* (Brinol, Petty, Valle, Rucker, & Becerra, 2007; Galinsky, Magee, Gruenfeld, Whitson, & Liljenquist, 2008). Clinicians who do not feel that they have the autonomy to practice independent of organizational constraints are unlikely to form the intention to assess appropriateness before recommending a service if they believe that the organization values high utilization rates. For example, in a recent qualitative study on organizational implementation of a performance measurement system, many nonphysician providers felt that they were required to provide all preventive health services that were indicated as being due in the medical record without questioning their appropriateness (Powell et al., 2012).

Control beliefs are also influenced by the PCPs' *perceptions of patients' willingness to accept a recommendation* against a service. Providers who believe that a patient will be unreceptive to a recommendation against a service are more likely to skip the assessment of appropriateness and simply agree to provide the service (I. B. Wilson, Dukes, Greenfield, Kaplan, & Hillman, 2001). This is especially troubling since PCPs have been found in some studies to be both inaccurate in their assumptions about patient expectations (Hamm, Hicks, & Bemben, 1996) and unaware of the degree to which their perceptions of patient expectations influence their recommendations (Moro, Marchi, Gagliotti, Di, & Resi, 2009). Research on antibiotic prescribing indicates that some PCPs even alter their diagnoses to make it easier to provide antibiotics to patients who they believe expect them (Mangione-Smith, McGlynn, Elliott, Krogstad, & Brook, 1999). Patients may, however, be more willing to accept a recommendation against a service than providers realize. Survey research suggests that even for primary care services that patients consider important, such as cervical cancer screening (Oboler, Prochazka, Gonzales, Xu, & Anderson, 2002; Sawaya et al., 2009),

most patients are willing to forgo or reduce the frequency of services if recommended by physicians or guidelines (Meissner, Tiro, Yabroff, Haggstrom, & Coughlin, 2010; Sawaya et al., 2009). As health care systems increase their emphasis on patient-centered care, PCPs are likely to place even more weight on how their recommendations affect their relationships with patients (Flynn, Smith, & Davis, 2002).

PCPs are also unlikely to form an intention to assess appropriateness if they believe that they will not have *sufficient time* to synthesize this information while still completing other important tasks during the visit. Physicians report that they have less time than is required to address patients' health care needs (Linzer et al., 2009; Mechanic, 2003). Although shorter visit length has been associated with underuse of primary care services (Ruffin, Gorenflo, & Woodman, 2000; Thorndike, Rigotti, Stafford, & Singer, 1998), it may also lead to overuse of the same or different services if PCPs believe that recommending a service without first conducting an adequate appropriateness assessment will save time. Indeed, surveys of physicians indicate that even if a service is known to be inappropriate, physicians may provide it anyway because that is believed to be the quickest way to resolve the issue (Bendtsen et al., 1999; Srisurapanont et al., 2005). Time constraints may also create cognitive overload (Eppler & Mengis, 2004), which can lead to fatigue, a need for cognitive closure, and an overreliance on heuristics to drive care decisions (Petty, 1994), all of which can reduce the likelihood that an assessment of appropriateness is undertaken. Time limitations may be especially problematic for patients with chronic medical conditions (Guy & Richardson, 2012; Tsai, Abbo, & Ogden, 2011) because more time is required to treat these conditions and they are more likely to have contraindications that increase the importance of performing an adequate assessment of appropriateness.

A systematic review of interventions that increased the length of primary care appointments found no consistent effects of appointment length on the number of clinical services provided (A. Wilson & Childs, 2009). However, because longer appointments may reduce both underuse of appropriate services and overuse of inappropriate services, it is possible that increasing appointment length could result in more appropriate care without affecting the total number of services provided.

Interventions Affecting Control Beliefs. We know of no studies evaluating interventions to increase PCP autonomy as a means of reducing overuse; however, one would expect that providers would feel more autonomy to recommend against a service to the extent that *leadership expresses support* for efforts to reduce overuse. Prior studies on quality improvement initiatives have found leadership support to be associated with positive outcomes (Leape et al., 2006; Mills & Weeks, 2004).

Communication skills training may also affect PCP control beliefs if this training increases provider confidence that they will be able to convince their patients to accept their recommendation without damaging the provider–patient relationship. We identified two overuse interventions that utilized communication skills training. One failed to produce a significant reduction in overuse (Briel et al., 2006). The other (Welschen, Kuyvenhoven, Hoes, & Verheij, 2004) was much more effective (RRR = .32). However, the second study also incorporated audit and feedback, provider education

on the evidence base, and patient education components into the intervention. A recent meta-analysis found that communication skills training for providers increased patient adherence to a variety of provider recommendations by 12% (Zolnierek & Dimatteo, 2009), although these recommendations were aimed at increasing the use of services, rather than reducing overuse.

Although it is beyond the scope of this article to assess patient-targeted interventions, it should be noted that any changes in patient beliefs regarding the appropriateness of a service may also affect provider control beliefs by modifying provider perceptions about whether or not patients will accept a recommendation against a service.

The Assessment Process (Box G)

An intention reflects a motivation to engage in behavior; however, intentions do not guarantee action. During the clinical encounter, contextual factors may affect PCPs' ability to conduct an adequate assessment of the appropriateness of an intervention even if they intended to do so. The TPB proposes that control beliefs can affect behavior both indirectly through the formation of intentions (Figure 1, Path E $\rightarrow$ F $\rightarrow$ G) and directly (Path E $\rightarrow$ G). The direct path occurs because the same variables affecting one's beliefs about control can affect actual control. For example, general perceptions of time limitations during patient appointments may reduce the likelihood that PCPs form an intention to assess the appropriateness of these services when they are indicated as being due in the medical record (indirect path E $\rightarrow$ F $\rightarrow$ G). But even if an intention to assess the appropriateness of a service is formed, actual time limitations during the visit may make it difficult or impossible act on this intention (direct path E $\rightarrow$ G). Thus the previously reviewed interventions postulated to affect control beliefs should also affect the likelihood that an intention to assess the appropriateness of a service leads to assessment behavior.

An Appropriate Recommendation (Box H)

PCPs who engage in an assessment of appropriateness may or may not reach the correct conclusion. While engaging in the assessment process, providers rely on their beliefs about which patients are expected to benefit from a service. The accuracy of these beliefs affects the likelihood of a correct assessment (Path A $\rightarrow$ H). Thus, any interventions that affect provider beliefs about patient outcomes should influence provider recommendations through two paths. First, as previously described, these beliefs should affect a provider's intention to assess appropriateness. Second, these interventions should affect the knowledge that is drawn on during the assessment process.

Interventions to Facilitate Assessment Process. A variety of *decision support tools* have been developed and evaluated to reduce overuse in primary care. Many of these rely on point-of-care decision algorithms to simplify decision making or alert providers when contraindications exist. These point-of-care tools can affect the assessment of appropriateness

in two ways. First, by creating roadblocks to the indiscriminate ordering of services, these tools may increase the likelihood that an assessment of appropriateness occurs even if there was no a priori intention to assess appropriateness. Second, once assessment occurs, these tools may increase the likelihood of reaching the correct decision.

Decision support tools have had inconsistent effects on overuse rates (RRRs = *ns* to .47). Unlike decision aids that provide information only, algorithm-based decision aids do some or all of the assessment work for the provider. The value of these algorithm-based aids are therefore dependent on the accuracy of information that they draw on and the degree to which they are able to incorporate all relevant variables in the assessment of appropriateness. Overreliance on algorithms could, for example, lead to repeating a test too frequently if tests obtained outside of the health care system are missing from the data set used by the algorithm.

Patient Acceptance of PCP Recommendation (Box I)

Our framework is based on the premise that PCP recommendations affect patient behavior (Path H → I). Communications skills training interventions (reviewed in the previous section on control beliefs) should moderate this effect, increasing the likelihood that an appropriate provider recommendation is accepted by the patient.

As PCPs learn about the effects of their recommendations on patient behaviors and health outcomes, they incorporate this information into their beliefs about when it is worthwhile to take the time to conduct a complete assessment of appropriateness prior to recommending a service (I. B. Wilson et al., 2001). Through this feedback loop, all of the previously described interventions have the potential to eventually change provider beliefs.

Discussion

We have outlined a conceptual framework that can be used to investigate barriers to appropriate PCP recommendations of primary care services and to develop interventions that target barriers once identified. We based this framework on the TPB because we believe that as providers become familiar with the evidence supporting clinical services, they develop beliefs about the contexts in which these services are appropriate and form intentions to identify these contexts during the clinical encounter. The TPB assumes that actors are consciously aware of their beliefs and form deliberate intentions. This makes the framework particularly adaptable to survey and other self-report methods of research investigation. However, PCPs may be *unaware* of the factors that can prevent an intention (to assess the appropriateness of a service) from leading to a correct assessment and well-communicated recommendation. Thus, a complete assessment of barriers to appropriate provider recommendations requires behavioral data in addition to self-reports of cognitive variables. Combining these data sources will help to identify whether problems lie with lack of intent or with a breakdown between intention and behavior. This analysis should provide insight into what forms of interventions are most likely to reduce overuse.

A number of studies on overuse of primary care services identify attributes of patients, practitioners, or provider organizations that are correlated with overuse. For example, inordinately high use of some primary care procedures has been associated with patients who are male (Diette et al., 1999) or frequent health care users (Partin et al., 2012; Walter et al., 2009); PCPs who are nonphysicians (Guerry et al., 2005; Roumie et al., 2005), older (Kerfoot, Holmberg, Lawler, Krupat, & Conlin, 2007), or have a greater practice volume (Cadieux, Tamblyn, Dauphinee, & Libman, 2007); and rural and for profit organizations (Mathias, Feinglass, & Baker, 2012). Although these studies can improve the prediction of when overuse is more likely to occur, they do not specify why it occurs. We believe that any causal relationship between these variables and provider recommendations is indirect, occurring by affecting either provider beliefs or providers' ability to successfully act on an intention to assess the appropriateness of an intervention.

Our framework is limited to factors that influence PCP cognitions and behaviors. However, other interventions may reduce overuse without targeting PCPs. Patient-directed interventions, for example, may reduce inappropriate demand for services. Although reduced demand is not directly captured in our framework, if PCPs become aware of a change in patient attitudes toward a service, this awareness may affect their beliefs about the type of recommendations patients consider acceptable. These beliefs would then be expected to affect provider intentions and behaviors as specified in our framework.

Research both on reducing overuse (Arnold & Straus, 2005; Ranji, Steinman, Shojania, & Gonzales, 2008) and reducing underuse (Grimshaw et al., 2006) suggests that the most effective interventions involve the use of multiple strategies to change practice. However, multimodal interventions are expensive and complex and may be difficult to sustain. A possible solution is to use frameworks such as the one we propose to identify subgroups of PCPs with common barriers to appropriate use. A menu of interventions can then be developed and selectively applied at the PCP, clinic, or facility level to target the key barriers most relevant to the individual or group.

Overuse of health care services is common and has been identified as a critical improvement domain for the U.S. health care system (National Priorities Partnership, 2008). Our framework describes how PCP beliefs, intentions and actions may contribute to overuse. Additionally, we illustrate how several commonly used interventions may affect antecedents of overuse. Much more work needs to be done to empirically determine the validity of the framework and to establish whether the effects of the reviewed interventions are indeed mediated by the cognitive and behavioral variables that we propose. Even if future research fails to support aspects of our framework, it will have been of value if it stimulates a more theoretical approach to the development, evaluation, and reporting of interventions to reduce overuse.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was supported by Veterans Affairs Health Services Research and Development Career Development Award CDA 08–024 granted to Dr. Powell.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*, 179-211.

Ajzen, I. (2011). The theory of planned behavior: Reactions and reflections. *Psychology & Health*, *26*, 1113-1127.

Allard, J., Hebert, R., Rioux, M., Asselin, J., & Voyer, L. (2001). Efficacy of a clinical medication review on the number of potentially inappropriate prescriptions prescribed for community-dwelling elderly people. *Canadian Medical Association Journal*, *164*, 1291-1296.

Arnold, S. R., & Straus, S. E. (2005). Interventions to improve antibiotic prescribing practices in ambulatory care. *Cochrane Database of Systematic Reviews*, (4), CD003539.

Baker, R., Falconer Smith, J., & Lambert, P. C. (2003). Randomised controlled trial of the effectiveness of feedback in improving test ordering in general practice. *Scandinavian Journal of Primary Health Care*, *21*, 219-223.

Balague, F., & Cedraschi, C. (2006). Radiological examination in low back pain patients: Anxiety of the patient? Anxiety of the therapist? *Joint Bone Spine*, *73*, 508-513.

Bates, D. W., Kuperman, G. J., Rittenberg, E., Teich, J. M., Fiskio, J., Ma'Luf, N., & Tanasijevic, M. (1999). A randomized trial of a computer-based intervention to reduce utilization of redundant laboratory tests. *American Journal of Medicine*, *106*, 144-150.

Batson, C. D., Ahmad, N., & Tsang, J. (2002). Four motives for community involvement. *Journal of Social Issues*, *58*, 429-445.

Bendtsen, P., Hensing, G., McKenzie, L., & Stridsman, A. K. (1999). Prescribing benzodiazepines: A critical incident study of a physician dilemma. *Social Science & Medicine*, *49*, 459-467.

Blais, R., Laurier, C., & Pare, M. (2008). Effect of feedback letters to physicians and pharmacists on the appropriate use of medication in the treatment of asthma. *Journal of Asthma*, *45*, 227-231.

Briel, M., Langewitz, W., Tschudi, P., Young, J., Hugenschmidt, C., & Bucher, H. C. (2006). Communication training and antibiotic use in acute respiratory tract infections: A cluster randomised controlled trial in general practice. *Swiss Medical Weekly*, *136*, 241-247.

Brinol, P., Petty, R. E., Valle, C., Rucker, D. D., & Becerra, A. (2007). The effects of message recipients' power before and after persuasion: A self-validation analysis. *Journal of Personality and Social Psychology*, *93*, 1040-1053.

Bunting, P. S., & van Walraven, C. (2004). Effect of a controlled feedback intervention on laboratory test ordering by community physicians. *Clinical Chemistry*, *50*, 321-326.

Bynum, J. P., Braunstein, J. B., Sharkey, P., Haddad, K., & Wu, A. W. (2005). The influence of health status, age, and race on screening mammography in elderly women. *Archives of Internal Medicine*, *165*, 2083-2088.

Cadieux, G., Tamblyn, R., Dauphinee, D., & Libman, M. (2007). Predictors of inappropriate antibiotic prescribing among primary care physicians. *Canadian Medical Association Journal*, *177*, 877-883.

Campbell, S. M., Reeves, D., Kontopantelis, E., Sibbald, B., & Roland, M. (2009). Effects of pay for performance on the quality of primary care in England. *New England Journal of Medicine*, *361*, 368-378.

Chassin, M. R., & Galvin, R. W. (1998). The urgent need to improve health care quality. Institute of Medicine National Roundtable on Health Care Quality. *Journal of the American Medical Association*, *280*, 1000-1005.

Cialdini, R., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology*, *58*, 1015-1026.

Coenen, S., Van Royen, P., Michiels, B., & Denekens, J. (2004). Optimizing antibiotic prescribing for acute cough in general practice: A cluster-randomized controlled trial. *Journal of Antimicrobial Chemotherapy*, *54*, 661-672.

The Commonwealth Fund. (2011). *Why not the best? Results from the national scorecard on U.S. health system performance, 2011*. http://www.commonwealthfund.org/~/media/Files/News/Nat%20Scorecard/1500_WNTB_Natl_Scorecard_2011_web.pdf

Delaune, J., & Everett, W. (2008). *Waste and inefficiency in the US health care system. Clinical care: A comprehensive analysis in support of system-wide improvements*. Cambridge, MA: New England Healthcare Institute.

Diette, G. B., Wu, A. W., Skinner, E. A., Markson, L., Clark, R. D., McDonald, R. C., & Steinwachs, D. M. (1999). Treatment patterns among adult patients with asthma: Factors associated with overuse of inhaled beta-agonists and underuse of inhaled corticosteroids. *Archives of Internal Medicine*, *159*, 2697-2704.

Dukerich, J. M., Golden, B. R., & Shortell, S. M. (2002). Beauty is in the eye of the beholder: The impact of organizational identification, identity, and image on the cooperative behaviors of physicians. *Administrative Science Quarterly*, *47*, 507-533.

Eccles, M., Grimshaw, J., Walker, A., Johnston, M., & Pitts, N. (2004). Changing the behaviour of healthcare professionals: The use of theory in promoting the uptake of research findings. *Journal of Clinical Epidemiology*, *58*, 107-112.

Eccles, M., Steen, N., Grimshaw, J., Thomas, L., McNamee, P., Soutter, J., & Bond, S. (2001). Effect of audit and feedback, and reminder messages on primary-care radiology referrals: A randomised trial. *Lancet*, *357*, 1406-1409.

Eccles, M. P., Grimshaw, J. M., Johnston, M., Steen, N., Pitts, N. B., Thomas, R., & Walker, A. (2007). Applying psychological theories to evidence-based clinical practice: Identifying factors predictive of managing upper respiratory tract infections without antibiotics. *Implementation Science*, *2*, 26.

Eppler, M. J., & Mengis, J. (2004). The concept of information overload: A review of literature from organization science, accounting, marketing, MIS, and related disciplines. *Information Society*, *20*, 325-344.

Flottorp, S., Oxman, A. D., Håvelsrud, K., Treweek, S., & Herrin, J. (2002). Cluster randomised controlled trial of tailored interventions to improve the management of urinary tract infections in women and sore throat. *British Medical Journal*, *325*, 367.

Flynn, K. E., Smith, M. A., & Davis, M. K. (2002). From physician to consumer: The effectiveness of strategies to manage health care utilization. *Medical Care Research and Review*, *59*, 455-481.

Freeborn, D. K., Shye, D., Mullooly, S. P., Eraker, S., & Romeo, J. (1997). Primary care physicians' use of lumbar spine imaging tests: Effects of guidelines and practice pattern feedback. *Journal of General Internal Medicine*, *12*, 619-625.

Fung, C. H., Lim, Y. W., Mattke, S., Damberg, C., & Shekelle, P. G. (2008). Systematic review: The evidence that publishing patient care performance data improves quality of care. *Annals of Internal Medicine*, *148*, 111-123.

Galinsky, A. D., Magee, J. C., Gruenfeld, D. H., Whitson, J. A., & Liljenquist, K. A. (2008). Power reduces the press of the situation: Implications for creativity, conformity, and dissonance. *Journal of Personality and Social Psychology*, *95*, 1450-1466.

Gavagan, T. F., Du, H., Saver, B. G., Adams, G. J., Graham, D. M., McCray, R., & Goodrick, G. K. (2010). Effect of financial incentives on improvement in medical quality indicators for primary care. *Journal of the American Board of Family Medicine*, *23*, 622-631.

Godin, G., Belanger-Gravel, A., Eccles, M., & Grimshaw, J. (2008). Healthcare professionals' intentions and behaviours: A systematic review of studies based on social cognitive theories. *Implementation Science*, *3*, 36.

Good Stewardship Working Group. (2011). The "top 5" lists in primary care: Meeting the responsibility of professionalism. *Archives of Internal Medicine*, *171*, 1385-1390.

Gonzales, R., Steiner, J. F., Lum, A., & Barrett, P. H., Jr. (1999). Decreasing antibiotic use in ambulatory practice: impact of a multidimensional intervention on the treatment of uncomplicated acute bronchitis in adults. *Journal of the American Medical Association*, *281*, 1512-1519.

Grimshaw, J., Eccles, M., Thomas, R., Maclennan, G., Ramsay, C., Fraser, C., & Vale, L. (2006). Toward evidence-based quality improvement: Evidence (and its limitations) of the effectiveness of guideline dissemination and implementation strategies 1966-1998. *Journal of General Internal Medicine*, *21*, S14-S20.

Guerry, S. L., Bauer, H. M., Packel, L., Samuel, M., Chow, J., Rhew, M., & Bolan, G. (2005). Chlamydia screening and management practices of primary care physicians and nurse practitioners in California. *Journal of General Internal Medicine*, *20*, 1102-1107.

Guy, G. P., Jr., & Richardson, L. C. (2012). Visit duration for outpatient physician office visits among patients with cancer. *Journal of Oncology Practice, 8*, 2s-8s.

Hamm, R. M., Hicks, R. J., & Bemben, D. A. (1996). Antibiotics and respiratory infections: Are patients more satisfied when expectations are met? *Journal of Family Practice*, *43*, 56-62.

Hanlon, J. T., Weinberger, M., Samsa, G. P., Schmader, K. E., Uttech, K. M., Lewis, I. K., & Feussner, J. R. (1996). A randomized, controlled trial of a clinical pharmacist intervention to improve inappropriate prescribing in elderly outpatients with polypharmacy. *American Journal of Medicine*, *100*, 428-437.

Hennessy, T. W., Petersen, K. L, Bruden, D., Parkinson, A. J., Hurlburt, D., Getty, M., & Butler, J. C. (2002). Changes in antibiotic-prescribing practices and carriage of penicillin-resistant *Streptococcus pneumoniae*: A controlled intervention trial in rural Alaska. *Clinical Infectious Diseases*, *34*, 1543-1550.

Hickman, D. E., Stebbins, M. R., Hanak, J. R., & Guglielmo, B. J. (2003). Pharmacy-based intervention to reduce antibiotic use for acute bronchitis. *Annals of Pharmacotherapy*, *37*, 187-191.

How, S. K. H., Shih, A., Lau, J., & Schoen, C. (2008). *Public views on U.S. health system organization: A call for new directions* (Data Brief). Retrieved from http://www.commonwealthfund.org/Publications/Data-Briefs/2008/Aug/Public-Views-on-U-S−Health-System-Organization−A-Call-for-New-Directions.aspx

Hysong, S. J. (2009). Meta-analysis: Audit and feedback features impact effectiveness on care quality. *Medical Care*, *47*, 356-363.

Johnson, M. D., Morgeson, F. P., Ilgen, D. R., Meyer, C. J., & Lloyd, J. W. (2006). Multiple professional identities: Examining differences in identification across work-related targets. *Journal of Applied Psychology*, *91*, 498-506.

Juzych, N. S., Banerjee, M., Essenmacher, L., & Lerner, S. A. (2005). Improvements in antimicrobial prescribing for treatment of upper respiratory tract infections through provider education. *Journal of General Internal Medicine*, *20*, 901-905.

Kahn, K. L., Kosecoff, J., Chassin, M. R., Flynn, M. F., Fink, A., Pattaphongse, N., & Brook, R. H. (1988). Measuring the clinical appropriateness of the use of a procedure. Can we do it? *Medical Care*, *26*, 415-422.

Kerfoot, B. P., Holmberg, E. F., Lawler, E. V., Krupat, E., & Conlin, P. R. (2007). Practitioner-level determinants of inappropriate prostate-specific antigen screening. *Archives of Internal Medicine*, *167*, 1367-1372.

Klabunde, C. N., Marcus, P. M., Han, P. K., Richards, T. B., Vernon, S. W., Yuan, G., & Silvestri, G. A. (2012). Lung cancer screening practices of primary care physicians: Results from a national survey. *Annals of Family Medicine*, *10*, 102-110.

Kluger, A. N., & DeNisi, A. (1996). The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin*, *119*, 254-284.

Korenstein, D., Falk, R., Howell, E. A., Bishop, T., & Keyhani, S. (2012). Overuse of health care services in the United States: An understudied problem. *Archives of Internal Medicine*, *172*, 171-178.

Krska, J., Cromarty, J. A., Arris, F., Jamieson, D., Hansford, D., Duffus, P. R., & Seymour, D. G. (2001). Pharmacist-led medication review in patients over 65: A randomized, controlled trial in primary care. *Age and Ageing*, *30*, 205-211.

Leape, L. L., Rogers, G., Hanna, D., Griswold, P., Federico, F., & Fenn Clarridge, B. R. (2006). Developing and implementing new safe practices: Voluntary adoption through statewide collaboratives. *Quality & Safety in Health Care*, *15*, 289-295.

Linzer, M., Manwell, L. B., Williams, E. S., Bobula, J. A., Brown, R. L., Varkey, A. B., & Schwartz, M. D. (2009). Working conditions in primary care: Physician reactions and care quality. *Annals of Internal Medicine*, *151*, 28-29.

Mangione-Smith, R., McGlynn, E. A., Elliott, M. N., Krogstad, P., & Brook, R. H. (1999). The relationship between perceived parental expectations and pediatrician antimicrobial prescribing behavior. *Pediatrics*, *103*, 711-718.

Mathias, J. S., Feinglass, J., & Baker, D. W. (2012). Variations in US hospital performance on imaging-use measures. *Medical Care*, *50*, 808-814.

McIsaac, W. J., & Goel, V. (1998). Effect of an explicit decision-support tool on decisions to prescribe antibiotics for sore throat. *Medical Decision Making*, *18*, 220-228.

McIsaac, W. J., Goel, V., To, T., Permaul, J. A., & Low, D. E. (2002). Effect on antibiotic prescribing of repeated clinical prompts to use a sore throat score: Lessons from a failed community intervention study. *Journal of Family Practice*, *51*, 339-344.

McNulty, C. A., Kane, A., Foy, C. J., Sykes, J., Saunders, P., & Cartwright, K. A. (2000). Primary care workshops can reduce and rationalize antibiotic prescribing. Journal of Antimicrobial Chemotherapy, 46, 493-499.

Mechanic, D. (2003). Physician discontent: Challenges and opportunities. *Journal of the American Medical Association*, *290*, 941-946.

Meissner, H. I., Tiro, J. A., Yabroff, K. R., Haggstrom, D. A., & Coughlin, S. S. (2010). Too much of a good thing? Physician practices and patient willingness for less frequent Pap test screening intervals. *Medical Care*, *48*, 249-259.

Melander, E., Björgell, A., Björgell, P., Ovhed, I., & Mölstad, S. (1999) Medical audit changes physicians' prescribing of antibiotics for respiratory tract infections. *Scandinavian Journal of Primary Health Care*, *17*, 180-184.

Meyer, J. C., Summers, R. S., & Moller, H. (2001). Randomized, controlled trial of prescribing training in a South African province. *Medical Education*, *35*, 833-840.

Michie, S., Johnston, M., Abraham, C., Lawton, R., Parker, D., & Walker, A. (2005). Making psychological theory useful for implementing evidence based practice: A consensus approach. *Quality & Safety in Health Care*, *14*, 26-33.

Mills, P. D., & Weeks, W. B. (2004). Characteristics of successful quality improvement teams: Lessons from five collaborative projects in the VHA. *Joint Commission Journal on Quality and Safety*, *30*, 152-162.

Moro, M. L., Marchi, M., Gagliotti, C., Di, M. S., & Resi, D. (2009). Why do paediatricians prescribe antibiotics? Results of an Italian regional project. *BMC Pediatrics*, *9*, 69.

National Priorities Partnership. (2008). *National priorities and goals: Aligning our efforts to transform America's healthcare*. Washington, DC: Author.

Oboler, S. K., Prochazka, A. V., Gonzales, R., Xu, S., & Anderson, R. J. (2002). Public expectations and attitudes for annual physical examinations and testing. *Annals of Internal Medicine*, *136*, 652-659.

O'Connell, D. L., Henry, D., & Tomlins, R. (1999). Randomised controlled trial of effect of feedback on general practitioners' prescribing in Australia. *British Medical Journal*, *318*, 507-511.

Overbeck, J. R., & Park, B. (2006). Powerful perceivers, powerless objects: Flexibility of powerholders' social attention. *Organizational Behavior and Human Decision Processes*, *99*, 227-243.

Owens, D. K., Qaseem, A., Chou, R., & Shekelle, P. (2011). Clinical Guidelines Committee of the American College of Physicians. High-value, cost-conscious health care: Concepts for clinicians to evaluate the benefits, harms, and costs of medical interventions. *Annals of Internal Medicine*. *154*, 174-180.

Partin, M. R., Powell, A. A., Bangerter, A., Halek, K., Burgess, J. F., Jr., Fisher, D. A., & Nelson, D. B. (2012). Levels and variation in overuse of fecal occult blood testing in the veterans health administration. *Journal of General Internal Medicine*, *27*, 1618-1625.

Petty, R. E. (1994). Two routes to persuasion: State of the art. In G. d'Ydewalle, P. Eelen, & P. Berteleson (Eds.), *International perspectives on psychological science* (Vol. 2, pp. 229-247). Hillsdale, NJ: Lawrence Erlbaum.

Phillips, R. L., Jr., & Bazemore, A. W. (2010). Primary care and why it matters for U.S. health system reform. *Health Affairs (Millwood)*, *29*, 806-810.

Pimlott, N. J., Hux, J. E., Wilson, L. M., Kahan, M., Li, C., & Rosser, W. W. (2003). Educating physicians to reduce benzodiazepine use by elderly patients: A randomized controlled trial. *Canadian Medical Association Journal*, *168*, 835-839.

Powell, A. A., White, K. M., Partin, M. R., Halek, K., Christianson, J. B., & Neil Bloomfield, H. E. (2012). Unintended consequences of implementing a national performance measurement system into local practice. *Journal of General Internal Medicine*, *27*, 405-412.

Ramsay, C., Thomas, R., Croal, B., Grimshaw, J., & Eccles, M. (2010). Using the theory of planned behaviour as a process evaluation tool in randomised trials of knowledge translation strategies: A case study from UK primary care. *Implementation Science*, *5*, 71.

Ranji, S. R., Steinman, M. A., Shojania, K. G., & Gonzales, R. (2008). Interventions to reduce unnecessary antibiotic prescribing: A systematic review and quantitative analysis. *Medical Care*, *46*, 847-862.

Ransohoff, D. F., McNaughton, C. M., & Fowler, F. J. (2002). Why is prostate cancer screening so common when the evidence is so uncertain? A system without negative feedback. *American Journal of Medicine*, *113*, 663-667.

Rossi, R. A., & Every, N. R. (1997). A computerized intervention to decrease the use of calcium channel blockers in hypertension. *Journal of General Internal Medicine*, *12*, 672-678.

Roumie, C. L., Halasa, N. B., Edwards, K. M., Zhu, Y., Dittus, R. S., & Griffin, M. R. (2005). Differences in antibiotic prescribing among physicians, residents, and nonphysician clinicians. *American Journal of Medicine*, *118*, 641-648.

Ruffin, M. T., Gorenflo, D. W., & Woodman, B. (2000). Predictors of screening for breast, cervical, colorectal, and prostatic cancer among community-based primary care practices. *Journal of the American Board of Family Medicine*, *13*, 1-10.

Samore, M. H., Bateman, K., Alder, S. C., Hannah, E., Donnelly, S., Stoddard, G. J., & Stevenson, K. (2005). Clinical decision support and appropriateness of antimicrobial prescribing: A randomized trial. *Journal of the American Medical Association*, *294*, 2305-2314.

Sawaya, G. F., Iwaoka-Scott, A. Y., Kim, S., Wong, S. T., Huang, A. J., Washington, A. E., & Pérez-Stable, E. J. (2009). Ending cervical cancer screening: Attitudes and beliefs from ethnically diverse older women. *American Journal of Obstetrics & Gynecology*, *200*, 40. e1-40.e7.

Schectman, J. M., Schroth, W. S., Verme, D., & Voss, J. D. (2003). Randomized controlled trial of education and feedback for implementation of guidelines for acute low back pain. *Journal of General Internal Medicine*, *18*, 773-780.

Simon, S. R., Smith, D. H., Feldstein, A. C., Perrin, N., Yang, X., Zhou, Y., & Soumerai, SB. (2006). Computerized prescribing alerts and group academic detailing to reduce the use of potentially inappropriate medications in older people. *Journal of the American Geriatrics Society*, *54*, 963–8.

Sirovich, B. E., Woloshin, S., & Schwartz, L. M. (2011). Too little? Too much? Primary care physicians' views on US health care: A brief report. *Archives of Internal Medicine*, *171*, 1582-1585.

Srisurapanont, M., Garner, P., Critchley, J., & Wongpakaran, N. (2005). Benzodiazepine prescribing behaviour and attitudes: A survey among general practitioners practicing in northern Thailand. *BMC Family Practice*, *6*, 27.

Tamblyn, R., Huang, A., Perreault, R., Jacques, A., Roy, D., Hanley, J., & Laprise, R. (2003). The Medical Office of the 21st Century (MOXXI): effectiveness of computerized decision-making support in reducing inappropriate prescribing in primary care. *Canadian Medical Association Journal*, *169*, 549-556.

Thorndike, A. N., Rigotti, N. A., Stafford, R. S., & Singer, D. E. (1998). National patterns in the treatment of smokers by physicians. *Journal of the American Medical Association*, *279*, 604-608.

Tsai, A. G., Abbo, E. D., & Ogden, L. G. (2011). The time burden of overweight and obesity in primary care. *BMC Health Services Research*, *11*, 191.

Turner, J. C. (1999). Some current issues in research in social identity and self-categorization theories. In R. Ellemers, R. Spears, & B. Doosje (Eds.), *Social identity: Context, commitment, content* (pp. 6-34). Oxford, MA: Blackwell.

Van Herck, P., De Smedt, D., Annemans, L., Remmen, R., Rosenthal, M. B., & Sermeus, W. (2010). Systematic review: Effects, design choices, and context of pay-for-performance in health care. *BMC Health Services Research*, *10*, 247.

Verstappen, W. H., van der Weijden, T., Sijbrandij, J., Smeele, I., Hermsen, J., Grimshaw, J., & Grol, R. P. (2003). Effect of a practice-based strategy on test ordering performance of primary care physicians: A randomized trial. *Journal of the American Medical Association*, *289*, 2407-2412.

Walter, L. C., Lindquist, K., Nugent, S., Schult, T., Lee, S. J., Casadei, M. A., & Partin, M. R. (2009). Impact of age and comorbidity on colorectal cancer screening among older veterans. *Annals of Internal Medicine*, *150*, 465-473.

Welschen, I., Kuyvenhoven, M. M., Hoes, A. W., & Verheij, T. J. (2004). Effectiveness of a multiple intervention to reduce antibiotic prescribing for respiratory tract symptoms in primary care: Randomised controlled trial. *British Medical Journal*, *329*, 431.

Wilson, A., & Childs, S. (2009). Effects of interventions aimed at changing the length of primary care physicians' consultation (Review). *Cochrane Database of Systematic Reviews*, (1), CD003540.

Wilson, I. B., Dukes, K., Greenfield, S., Kaplan, S., & Hillman, B. (2001). Patients' role in the use of radiology testing for common office practice complaints. *Archives of Internal Medicine*, *161*, 256-263.

Wong, M. D., Manley, R. T., Stettin, G., Chen, W., & Salmun, L. M. (2010). Intervention to reduce unnecessary dispensing of short-acting beta-agonists in patients with asthma. *Annals of Pharmacotherapy*, *44*, 623-629.

Zhang, Y., Lee, B. Y., & Donohue, J. M. (2010). Ambulatory antibiotic use and prescription drug coverage in older adults. *Archives of Internal Medicine*, *170*, 1308-1314.

Zolnierek, K. B., & Dimatteo, M. R. (2009). Physician communication and patient adherence to treatment: A meta-analysis. *Medical Care*, *47*, 826-834.

Zwar, N., Wolk, J., Gordon, J., Sanson-Fisher, R., & Kehoe, L. (1999). Influencing antibiotic prescribing in general practice: A trial of prescriber feedback and management guidelines. *Family Practice*, *16*, 495-500.