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University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Dear Editor & Reviewer,

I have revised this paper upon consideration of your recommendations.

I believe many of the concerns you raised with the previous manuscript can be addressed by re-framing the paper. Three previous publications have examined Irish GPs and their decision-making concerning the adoption of new drugs, medical equipment and ICT. The primary objective of my paper is to collate their findings and consider them collectively and how they can be used to inform medical practitioners and policy makers. Therefore, I have now taken a somewhat different approach. I now submit this paper as a review article and I present the approach and findings of the three studies, as well as addressing their limitations. Finally, in the discussion section I consider these three studies in the context of previous literature and potential policy implications.

Therefore, I have removed all tables from the article, as it was never my objective to present data descriptions and empirical results, but rather highlight the key findings of these three studies and bring them together in the one place for your readers. Data and methods sections have previously been presented in these three well regarded publications. I believe the paper is easier to follow in its current form and fulfils its objectives more clearly.

The paper now follows a more sensible layout and the abstract is structured with standard headings. All footnotes have been removed.

I look forward to your response.

Prescribing and Practice Development Decision-Making in Irish General Practices

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Prescribing and Practice Development Decision-Making in Irish General Practices

Abstract

Background

In Ireland, primary care is considered the appropriate setting to meet the majority of health and personal social service needs, with GPs central to its provision. Irish general practices are characterised by considerable autonomy in terms of commercial practice and the range of medical services they provide; however, little is known about what influences their decision-making with respect to the adoption of new health care technologies.

Aim

The aim of this paper is to provide a holistic overview on prescribing and practice development decision-making in Irish general practices.

Methods

A review of recent publications examining the factors influencing the adoption of new drugs, medical equipment and information and communications technology (ICT) by Irish GPs is undertaken.

Results

These studies identify experiential learning, connectedness with others and GP and practice characteristics as significant influences in the adoption of new drugs, medical equipment and ICT in Irish general practices.

Conclusions

This review identifies possible levers for encouraging the adoption of health care technologies by Irish GPs.

Introduction

GPs provide a range of services to their patients, including patient examination and diagnosis, prescription of medication, ordering of tests, performance of minor surgeries, and referral of patients to other health care providers [1]. Health care outcomes are dependent on a range of factors; however, GPs face strong clinical, economic and social incentives to adopt and use new technologies in the prevention and treatment of health problems [2, 3]. GPs' decision to adopt and use new technologies has direct implications for their patients. GPs with better access to diagnostic tests more appropriately diagnose, refer and treat patients, positively influencing medical outcomes and patient satisfaction [4-6]. In addition, an important element of the process by which new drugs receive widespread use is their adoption by GPs [7, 8]. Furthermore, ICT in primary care improves consistency and quality of care and reduces risk, as well as improving practice management [9-11]. However, to date, there is little empirical evidence of what factors influence Irish GPs in such decision-making.

Recently, three publications - *In with the new: the determinants of prescribing innovation by Irish general practitioners*, *the influence of experiential learning on medical equipment adoption in general practices* and *ICT use in Irish general practices: an intra-practice*

adoption study (hereafter referred to as the prescribing, medical equipment and ICT studies) – address the issue of what determines Irish GPs' adoption of new drugs, medical equipment and ICT [12-14].

These three studies are the first to comprehensively examine adoption decision-making by Irish GPs. These studies investigate such decision-making through an economic lens, and draw on a large innovation literature which has largely been applied to technology adoption by businesses. Although, more recently, a similar approach has been applied to the adoption of hospital information systems in the United States [15]. While some of the main contributions of these studies are theoretical and methodological in nature, it is their contribution to knowledge and policy which is reviewed here. This review collates these studies to provide a holistic, fully-informed perspective of the adoption and use of health care technologies in general practice in Ireland; thus, providing medical professionals and policy makers with an in-depth profile of Irish general practices and the factors influencing their adoption and use of new technologies and innovations.

This review of three empirical studies is organised as follows. In the next section, the adoption decision-making environment in Irish general practice is briefly discussed, the conceptual lens through which adoption decision-making by GPs is examined in all three studies is presented, as well as the data and methods employed. Next, the key empirical findings from the three studies are presented. In addition, study limitations in relation to the three studies are considered. Finally, the studies examined here are placed in the context of previous literature, and potential policy implications are discussed.

GPs and Adoption Decision-Making

GPs are frequently profiled as economic agents who respond to economic incentives and are aware of the competitive structure of their environment [16, 17]. Irish GPs are essentially independent contractors with considerable autonomy in how they choose to run their practices [18, 19]. The three studies reviewed here explain how Irish GPs' prescribing, investment and practice development decisions are likely shaped by both pecuniary (income generation) and non-pecuniary (health care service provision) factors. Specifically, they address the following questions: 1) what are the determinants of the timing of adoption of new prescription drugs by Irish GPs, 2) what influences the use of medical equipment in Irish general practices, and 3) what factors influence the intensity of ICT use in Irish general practices?

The nature of such decision-making (e.g. prescribing a new drug for the first time or investing in new equipment) will influence the trade-off between altruistic and commercial motives. For instance, the prescribing adoption decision differs from other adoption decisions in that a GP prescribes a drug to a patient to treat a particular condition or ailment; therefore, in weighing up the costs and benefits of adoption of a new drug a GP is primarily concerned with the clinical efficacy of the drug which will have a direct impact on their patient's health. Irish GPs are not directly affected financially from prescribing decisions, and so prescribing

decisions are likely to be primarily altruistic in nature. On the other hand, practices which invest in medical equipment and ICT improve service provision, but also incur the financial outlay for such equipment. Therefore, all three studies assume that Irish GPs maximise utility functions that are increasing in profits and service delivery. In other words, GPs gain satisfaction from adopting innovations which improve service provision to their patients and are commercially attractive. The authors explain that this assumption dictates that GPs will choose to adopt an innovation when their utility (or satisfaction) post adoption is greater than their utility pre-adoption. Characteristics of each innovation, as described above, will dictate the different weights GPs assign to the pecuniary and non-pecuniary elements of their utility functions. Different GPs may also place very different weights on their evaluations of the value of any new services. In addition, factors, such as patient profile or geographical position, may influence the potential to generate revenue streams from any given service. Furthermore, GP characteristics, their adoption decision-making to date and their connectedness with others are also important factors in such decision-making [12-14].

Theoretical Approach

These studies draw on three complementary approaches, which reflect the individual and environmental factors discussed above, to examining adoption decision-making. First, disequilibrium models reflect the learning and informational influences on adoption decision-making [20]. In these models, information is asymmetric and adoption is driven by information flows. These models are often referred to as epidemic models because they assume that a potential user of a new innovation will adopt it upon learning of its existence from other users [21]. In this context, epidemic is used to describe the spread of information about a technology through a community of GPs; in much the same way as it is often used to describe the spread of infectious disease in a community at a particular time. Therefore, variables which measure connectedness, such as practice location and interaction with suppliers and educators, are used to measure epidemic effects. Second, equilibrium models take account of how organisation characteristics and strategic interactions influence the returns from adoption [22]. In these models, practice heterogeneity is considered one of the key drivers in adoption decision-making, and so variables measuring GP and practice characteristics are included in these studies. Third, learning-by-using models reflect cumulative learning experience from previous adoption decisions influencing adoption [23]; and variables, capturing GPs adoption experience (e.g. breadth of prescribing portfolio), are also included.

Drawing on this encompassing theoretical framework, these three studies examine the influences of practice characteristics (equilibrium effects), learning and knowledge spillovers (epidemic effects) and cumulative learning from previous adoption decisions (learning-by-using effects) on the perceived benefits of adopting and using new prescription drugs, medical equipment and ICT in Irish general practices.

Data and Methodology

The data source for the prescribing study comprised a matched database that brought together information on GPs prescribing history (the GMS Prescribing Database) with information on

the characteristics of GPs themselves (the GP Characteristics Database) [12]. This database provides information on all prescriptions written by a sample of 625 GPs for GMS patients from October 1999 to March 2004. GMS patients are public patients who are entitled to attend GPs free of charge and receive prescription medicines free of charge. During this period, approximately 30 per cent of the Irish population were entitled to GMS medical cards [1]. In line with previous literature, a prescribing innovation is when a GP prescribes a new drug to at least one patient on at least one occasion [20, 24]. The prescribing study focused on six new-to-market drugs which operate on different physiological organs or systems eliminating any potential inter-relationships between adoption patterns that might stem from individual GPs having a particular interest in a certain therapeutic area or medical condition.

The *Medical Equipment and IT in General Practice* 2010 survey provided the data for the medical equipment and ICT studies [25, 26]. This self-administered questionnaire provides information for 601 Irish general practices concerning practice structure and use of medical equipment and ICT. The medical equipment study focused on six items of medical equipment used to diagnose, monitor and treat different therapeutic conditions which are widely used in general practices. The third paper examines ICT use, which general practices use for a variety of reasons ranging from billing patients and writing referral letters to keeping consultation records and coding diseases. Almost all Irish general practices are computerised, although there is substantial variation in the ICT applications used [25, 27]. The third study focuses on the extent of ICT use for both administrative and patient care purposes.
In the three studies, advanced econometric analysis was conducted to identify the factors which influence GPs adoption decision-making with respect to new drugs, medical equipment and ICT. See prior publications for detailed descriptions of the datasets and methodology employed [12-14].

Next, we present the key findings from these three studies with respect to learning-by-using effects, GP and practice characteristics and epidemic effects.

Key Findings

Learning by Using effects

Across all three studies, consistently strong evidence of learning-by-using effects on GP's innovative behaviour is reported. Learning-by-using effects occur when potential adopters adopt a new technology earlier if they have cumulative learning experience from previous adoption decisions. The prescribing study reports earlier adoption of new drugs by GPs with broader prescribing portfolios. This finding was strongly statistically significant for all six drugs examined. GPs who prescribe from a broader portfolio of drugs are more likely to prescribe a new drug sooner than their counterparts who prescribe from a narrower portfolio. In the medical equipment study, the authors report that practices with a large portfolio of medical equipment are more likely to invest in new medical equipment. Again, this finding was statistically significant for all six items of medical equipment examined. In the ICT study, the authors report that practices which are more intensive users of ICT for administrative purposes are more likely to be use a greater number of patient care ICT

applications and vice versa. They suggest that this is evidence of cumulative learning impacting on intensity of ICT use for both administrative and patient care purposes.

GP and practice characteristics

In these studies, practice characteristics are measured by variables such as nursing and administrative support, patient numbers and GP age. In relation to prescribing innovation, younger GPs and those who work with the support of a nurse and secretary are early adopters of new drugs. With respect to medical equipment use, there is evidence that practices with nursing support, high patient numbers, larger practices and male-dominated practices are more likely to use medical equipment. Larger practices and those with high proportions of private patients are more likely to be intense ICT users for administrative purposes. In addition, practices with nursing support and younger GPs are more likely to be intense ICT users for patient care purposes.

Epidemic Effects

Across the three aspects of adoption decision-making examined, evidence of epidemic or learning effects is reported. In the prescribing study, the authors report slower adoption of new drugs by rural GPs. In both the medical equipment and ICT studies, training practices are more likely to be extensive users. In addition, practices frequently visited by suppliers are reported to be more intensive users of ICT. The ICT study finds that professional and academic activity positively influences ICT use.

In both the medical equipment and ICT studies, the authors report some counter-intuitive findings. In Ireland, there is a higher proportion of solo-practitioner practices in the HSE West, and to a lesser extent, in the HSE South [25, 26]. It would be reasonable to expect geographically remote, solo-practitioner practices to be slower adopters of new technologies, however practices located in HSE West are more likely to have some items of medical equipment, and practices located in the HSE West and South are more likely to be more intensive users of ICT than their other HSE area counterparts. However, it is worth noting that the authors of the prescribing study report no influence from HSE region on prescribing patterns.

Insignificant results

The above is a synopsis of the key results from these three studies. However, at this point, it is important to highlight variables that were not influential for adoption decision-making by Irish GPs. For instance, the impact of the Indicative Drug Treatment Scheme (IDTS), developed in the early 1990's by the Irish government to try to contain prescribing costs, was included in the prescribing analysis. This initiative provided incentives for GPs to reduce prescribing costs and receive a percentage of the savings made to invest in their practice. A priori, it was expected that the IDTS would influence prescribing innovation. GPs seeking to reduce prescribing costs in order to benefit from the scheme might delay prescribing new – and possible more costly- drugs. Alternatively, if new drugs were more cost effective than existing treatment, the IDTS might actually encourage prescribing innovation. However, the IDTS was not identified as a significant driver of prescribing innovation. While the IDTS was

a mechanism for funding equipment in practices, it was not included in the *Medical Equipment and IT in General Practice* survey or resultant analyses as it was no longer in operation at the time of data collection [28].

Limitations

Limitations of all three studies, primarily due to data restrictions, are discussed next. In relation to the prescribing study, the GMS and GP Characteristics Databases provide a rich source of hard data in relation to Irish GPs and their prescribing patterns. However, the characteristics of GPs and their practices are quite limited, and the data source does not provide measures for epidemic effects, such as training practice, supplier visits and professional and academic activity. In fact, the only epidemic effect variable used in the analysis is practice location as measured by whether the GP is in receipt of a rural practice allowance. However, it is worth noting that individual epidemic effects are not particularly consistent in terms of impacting on adoption and use of medical equipment and ICT.

In the prescribing study, there is no attempt made to control for the impact of advertising in relation to GPs decisions to adopt new drugs. The authors suggest that advertising noise or impact could be measured through a citation search in medical journals or ranking the market power of the pharmaceutical companies which initially released these drugs. However, they do not do so.

The *Medical Equipment and IT in General Practice* database limits the analysis in the medical equipment and ICT papers to a certain extent. The database comprises cross-sectional data rather than the observed behaviour of GP practices over a period of time. This limits the complexity of the analytical approach, particularly as there is no historical information on the changing characteristics of the practices themselves. Second, the survey-based nature of the study – although covering around a third of Irish GP practices – raises potential issues of selection and response bias. Overcoming such issues entirely would require the use of real time administrative (or purchasing) data on practices' adoption history, data which is currently not available for Ireland.

Neither the medical equipment nor ICT study pays much attention to pricing impacts on adoption; which given the self-employed nature of GPs in Ireland and the considerable financial outlay required to invest in some items of equipment is perhaps an oversight.

Limitations not withstanding; these three studies provide us with a holistic perspective on decision-making by Irish GPs concerning prescribing and practice development decision-making. In the next section, the findings from these papers are discussed.

Discussion

The three studies demonstrate that Irish GP's decision-making is influenced by informational and learning stimuli. In fact, they exhibit capabilities for accumulating knowledge and learning from experience with technologies which informs ensuing adoption decisions. The

authors suggest that their findings reveal that Irish GPs are incentivised by commercial and market considerations. It is likely that the autonomy enjoyed by Irish GPs in how they equip their practices and what drugs they prescribe to their patients fosters an innovative, business approach. Their findings are broadly in line with previous European research which also reports more innovative patient care by self-employed GPs than salaried GPs [29].

In all three studies, the authors stress the importance of the learning-by-using effects in influencing adoption decision-making by Irish GPs. Therefore, limited experience, whether in relation to new drugs, medical equipment and/or ICT, negatively affects subsequent prescribing and practice development decisions. These findings are in line with previous business innovation studies where the influence of cumulative learning on adoption decisions is often reported [30-32].

In Ireland, investments in medical equipment are borne by the practice. If policymakers want to influence investment in medical equipment to ensure consistent service provision, they need to consider targeting poorly equipped practices who are the least likely to invest in new equipment or extensively use their ICT system. The authors point to the UK's NHS, ‘hub and spoke’ service delivery models for consideration in terms of influencing practice development in Ireland. In general, a ‘hub’ would be a larger better-equipped centre of excellence, with a number of ‘spokes’, i.e. smaller centres, in the same geographical area. Such a model in a primary care setting enables the provision of a wider range of services across a geographical area without the need for individual practices to make considerable investments in medical equipment [13].

A consistent finding in all three studies is the positive influence of nursing support for adoption decision-making. Previous studies report the importance of human capital in adoption decision-making [22, 33], and more specifically the positive influence of nursing support on the use of medical technologies [34]. It is important to note that legislation introduced in 2009 gave prescriptive authority to nurses and midwives in Ireland. However, this legislation was not in place during the period examined in the prescribing study. In addition, practice nurses do not typically make investment and practice development decisions. However, it is clear their role and influence cannot be overlooked. It may be the case that practices with nursing support are more patient-focused and/or service orientated and so more likely to make prescribing and investment decisions which benefit their patients. However, the authors do not consider the possible impact of GMS staffing support subsidies in this regard.

As expected, training practices are leading the way in terms of medical equipment and ICT use. A UK study also reports that training practices were more likely to use medical equipment than their non-training counterparts [23]. Of course in the Irish context, financial incentives, such as subsidies, are likely to explain some of this decision-making; however, the increased opportunity for knowledge acquisition and transfer by training practices is also likely to influence their adoption decisions.

The ICT study reports that GPs engaging in professional and academic activities are more extensive users of ICT. The more knowledge and information acquired by GPs; the more likely they are to adopt equipment. Thus, the authors suggest that consideration should be given to the possibility of positive externalities resulting from university-affiliated general practice research networks (for example, the Western Research and Education Network (WestREN) is collaborative network consisting of the Discipline of General Practice at the NUI Galway and West of Ireland general practices).

Of interest too are the findings reported in relation to HSE region. The medical equipment study finds that practices in the HSE West are better equipped in terms of medical equipment. This finding may be highlighting a 'compensation' effect whereby the smaller and more remote HSE West practices with less access to secondary health care services invest in a greater portfolio of services for their patients. Previous studies also report a higher availability of medical equipment in rural practices regardless of the type of health care system [6, 35-37].

In addition, the ICT study reports that practices in the HSE South are more likely to be intensive users of ICT for both administrative and patient care purposes. In 2001, the Southern Health Board developed an ICT Strategy to improve service delivery. The European Commission acknowledged the HSE South's ICT Strategy with a "Best Practices in eService Delivery" award. An evaluation of the HSE South's ICT strategy demonstrates how a system-level approach to eHealth maximises the use of technology [38]. It is likely that this system-level strategy results in knowledge spillovers (i.e. an exchange of ideas) and, in turn, influences how GPs use ICT in their practices. The authors explain that IT strategies such as this one may have far-reaching benefits in terms of providing physicians with knowledge and expertise which may increase ICT use and efficiencies in health care organisations.

The research reviewed here suggests that the general practice environment in Ireland facilitates and incentivises decision-making with respect to practice development and health care provision. These studies identify the influence of informational and learning stimuli, as well as economic and commercial motivations, on adoption and use of new drugs, medical equipment and ICT in general practice in Ireland. However, the current economic climate is placing considerable pressure on all sections of Irish health care, which is without doubt impacting practice development in Ireland. Irish policymakers need to consider the findings of these studies, which are specific to general practice in Ireland, when attempting to influence prescribing and practice development decision-making.

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