

**Identifying pathways from quality of care to outcomes and satisfaction in
Primary Care using structural equation modelling**

ABSTRACT

Objective: To study the relationships between the different domains of quality of primary healthcare for the evaluation of health system performance and informing policy decision making.

Data Sources: 137 quality indicators collected from 7,607 English practices between 2011-2012.

Study design: Cross-sectional study at the practice level. Indicators were allocated to sub-domains of processes of care (“quality assurance”, “education and training”, “medicines management”, “access”, “clinical management” and “patient-centered care”), health outcomes (“intermediate outcomes” and “patient-reported health status”) and patient satisfaction. The relationships between the sub-domains were hypothesized in a conceptual model and subsequently tested using structural equation modelling.

Principal Findings: The model supported two independent paths. In the first path, “access” was associated with “patient-centered care” ($\beta=0.63$), which in turn was strongly associated with “patient satisfaction” ($\beta=0.88$). In the second path, “education and training” was associated with “clinical management” ($\beta=0.32$), which in turn was associated with “intermediate outcomes” ($\beta=0.69$). “Patient-reported health status” was weakly associated with “patient-centered care” ($\beta=-0.05$), and “patient satisfaction” ($\beta=0.09$), and not associated with “clinical management” or “intermediate outcomes”.

Conclusions: This is the first empirical model to simultaneously provide evidence on the independence of all intermediate health care outcomes, patient satisfaction, and health status. The explanatory paths via technical quality clinical management and patient centeredness offer specific opportunities for the development of quality improvement initiatives.

Key words: Primary Health Care; clinical quality; health care; patient experience; quality indicators; quality of health care; technical quality of care.

BACKGROUND

Providing high-quality clinical care is a clear priority for most healthcare systems (Kocher, Emanuel, and DeParle 2010). There is a general agreement that quality of care is a complex and multidimensional construct (Donabedian 1980; Steffen 1988; Lohr, Donaldson and Harris-Wehling 1992; Bull 1994; Winefield, Murrell, and Clifford 1995; Evans et al. 2001; Harteloh 2003; Howie, Heaney, and Maxwell 2004; Cooperberg, Birkmeyer, and Litwin 2009; Gardner and Mazza 2012). One commonly accepted definition conceptualizes the quality of health care as to whether individuals can access the health structures and processes of care which they need and whether the care received is effective, thereby focusing on the domains of access and effectiveness (Campbell, Roland, and Buetow 2000). There is substantial variation in the domains proposed in the different definitions and, not surprisingly, a range of approaches have been used to measure quality of care focusing on efficiency, technical quality, patient centeredness, patient satisfaction, or health outcomes, among other (Goodwin et al. 2011).

Understanding the nature of the potential associations between these different domains of healthcare quality, and how they can help predict health outcomes has important implications for research (e.g. to inform the choice of measures) and healthcare configuration (e.g. to inform resource allocation). This issue has been the focus of a substantial number of studies. Some of them have examined the association between the quality of technical aspects of clinical care and patient satisfaction (Safran et al. 1998; Schneider et al. 2001; Gandhi et al. 2002; Chang et al. 2006; Rao et al. 2006; Sequist et al. 2008; Fenton et al. 2012; Llanwarne et al. 2013). Other studies have examined the relationship between access to healthcare and patient satisfaction (Kontopantelis, Roland and Reeves, 2010), between quality of care and health outcomes (Mold et al. 2011), between patient centeredness and satisfaction (Kinnersley et al. 1999; Paddison et al. 2015), between patient centeredness and

health outcomes (Kinnersley 1999; Shi et al. 2002), and between health outcomes and satisfaction (Alazri and Neal 2003; Marshall, Hays and Mazel 1996; Sequist et al. 2008).

The lack of consistent findings across these studies (Mead and Bower 2002; Doyle, Lennox, and Bell 2013) can be at least partially attributed to the heterogeneity among them in terms of health system organization and Primary Care orientation. Crucially, until now, research on this field has been restricted to pairwise examinations (Marshall, Hays and Mazel 1996; Schneider et al. 2001; Alazri and Neal 2003; Shi et al. 2002; Rao et al. 2006; Kontopantelis, Roland, & Reeves, 2010; Mold et al. 2011; Fenton et al. 2012; Llanwarne et al. 2013; Paddison et al. 2015) or, less frequently, the evaluation of a reduced number of domains of healthcare quality (Safran et al. 1998; Kinnersley 1999; Gandhi et al. 2002; Chang et al. 2006; Sequist et al. 2008), offering only a partial and fragmented picture of the complex network of associations between them. Simultaneously modelling the association between multiple domains of healthcare quality in a single (and large) population would address this gap, offering a more complete and comprehensive approach, testing whether the previous piecemeal approach corresponds to an empirical (not just theoretical) model, minimizing confounding and providing more valid estimations of the existing associations.

This study attempted to provide a unifying model by exploring potential relationships between various domains of care known to be markers of 'quality'. The aim of this study was to examine the associations between the different domains of quality of primary healthcare in family (general) practices in England.

METHODS

Data sources

We conducted a cross-sectional study using data from English family practices. In England family practices are the places where general practitioners (GPs) work. They usually work as part of a team which includes nurses, healthcare assistants, practice managers, receptionists and other staff. The vast majority of the population is registered with a family practice for the provision of primary care services which are free at the point care. Computerization is almost complete (with electronic medical records operating in the vast majority of the practices) and driven by participation in the profitable the Quality and Outcomes Framework (QOF), a national pay-for-performance scheme (Roland 2004).

Data on indicators for quality of the healthcare provided by family practices in England for the financial year 2011-2012 was obtained from reporting systems for two major quality improvement initiatives in primary care in England: the QOF (Roland 2004), and the GP Patient Survey (GPPS) (Campbell et al. 2009).

QOF is a voluntary scheme that financially rewards practices for their performance across a range of quality indicators. In the financial year 2011-2012 it included a total of 141 indicators. QOF data can be obtained from the Quality Management and Analysis System (QMAS), which automatically extracts data from the clinical record systems of practices. For each QOF indicator practices accumulate points according to their level of achievement, each point being associated with a financial benefit.

The GPPS is a survey capturing the experiences of patients who have been continuously registered with a practice for at least 6 months. This survey includes 46 questions, and is mailed each year to 2.7 million patients. 246 indicators of quality of care as perceived and self-reported by patients are derived from the survey. Each indicator depends on the percentage of patients from a practice giving a specific answer to an item in the survey

(e.g., percentage of patients rating their experience of their GP surgery as “very good”). The overall mortality-adjusted response rate was 40% for the 2011-2012 year. Additional details of the survey are available elsewhere (Campbell et al. 2009).

All the data above described was extracted from the Health & Social Care Information Centre (Health and Social Care Information Centre 2015).

Study sample

The dataset contained a total of 8,433 practices (99% of all practices in England). Of these, 310 practices did not contain QOF data, and 99 had no data relating to GPPS (possibly on account of merging and reconfiguring of practices within the data collection timeframe relevant to this study) and were excluded. Thirteen practices were also excluded because they offered only non-standard services (e.g. walk in services, addiction services) or have skewed patient populations (e.g. only care home or university students). Additionally 404 practices had incomplete data on some GPPS indicators (most frequently on the indicator measuring “frequency of seeing preferred GP”) and were excluded, leaving 7,607 practices in the final dataset (91.2% of all practices in England). Generally, the 404 practices excluded due to incomplete data in some GPPS indicators were very similar (according to the data extracted about their characteristics) to those that remained included.

Development of the conceptual model

A conceptual model was developed to describe hypothesized relationships between the different domains of quality of healthcare and health outcomes. The model, based on the conceptualization of quality of healthcare proposed by Donabedian (Donobedian 1966), was developed in an iterative process started by two members of the research team, and subsequently reviewed and approved by the all members of the team. We operationalized

fundamental domains for quality of care relating to structure (access), processes of care (clinical management, person centeredness), and outcomes (intermediate outcomes, health status, and patient satisfaction); and hypothesized the relationships between them (see Online Appendix 1). Subsequently we examined all the indicators available in the two datasets, and allocated them to the putative domains of quality, adding domains where a homogeneous set of indicators measuring a distinct area of quality was not covered by existing domains. Indicators that did not offer information for any of the fundamental domains were not included in the study. Although not originally a criterion for the identification of domains, the resulting domains exclusively contained indicators from one of the two data sources, but not both. The allocation of QOF indicators to each of the domains was to a large degree based on the indicators' classification produced by the National Institute for Health and Care Excellence (Prescribing and Primary Care team, Health and Social Care Information Centre 2012). The allocation of GPPS indicators was based on previous work that identified a set of composite markers that summarize the different aspects of the survey (Sizmur 2012).

For items in the GPPS we selected those indicators retaining the maximum amount of information based on the distribution of the scores at practice level (i.e., the indicators corresponding to the response category most frequently selected by respondents). These were consistently those capturing the most positive healthcare experience (e.g., 'very good' experience of making an appointment as opposed to other potential responses to that item). Finally, "health status" indicators were obtained from the responses to the EQ-5D (Brooks 1996), a standardized measure of health outcomes that was administered as part of the GPPS.

As part of its development process, the model was redefined because of inadequate fit. This was undertaken based on clinical and statistical criteria, and consisted in removing from the model the latent variables "records and information" (mostly related to information systems), and "overall structure" (accounting for key structural characteristics of the

practices). The final model included the following nine domains (137 indicators): quality assurance (16), education and training (6), medicine management (8), access to the practice (9), clinical management (70), patient-centered care (12), patient satisfaction (2), intermediate health outcomes (9), and health status (5). The complete list of indicators used to measure each of the domains is available in the Online Appendix 2.

Statistical analysis

We used a hybrid structural equation model (SEM) combining factor and path analysis (Kline and Santor 1999) to empirically test the associations between the quality domains hypothesized in the conceptual model.

Prior to analysis, an assessment of model identification was made using the two-step rule (Bollen 1989). Latent variables were constructed to measure each of the quality domains based on the indicators allocated to each of them. The suitability of the allocation of each indicator to its corresponding domain was examined based on their loadings after confirmatory factor analysis and their internal consistency (Cronbach's alpha). A correlation matrix for all the latent variables was subsequently constructed. Finally the association between domains was tested with path analysis.

Statistical analysis comprised the estimation of non-standardized and standardized coefficients for the conceptual model (using the maximum likelihood estimator) and assessments of model fit (assessment of Chi-squared (Kline 2015), Standardized Root Mean Squared Residual (SRMR) (Kline and Santor 1999), Comparative Fit Index (Hoyle 1995), Root Mean Squared Error of Approximation (RMSEA), and equation-level goodness of fit).

We needed to redefine the model because of inadequate fitness. This was done based on clinical and statistical criteria and consisted in removing from the model the latent variables "records and information" (mostly related to information systems based on alerts),

and “overall structure” (accounting for all the structural characteristics of the practices that would affect healthcare quality). Once an adequate model was successfully identified, we tested a number of alternative similar models to better understand the associations between the different domains and to examine the consistency of our findings against different data modelling approaches (Hays and White 1987). More specifically, five alternative models were tested in order to explore: 1) reversed causality for some of the hypothesized associations (e.g. patient satisfaction impacting on self-reported health rather than vice versa), and; 2) impact of allocating indicators into broader domains (e.g. collapsing the domains “quality assurance”, “education and training”, and “medicine management” into a single “structure of care” domain). The initial alternative models failed to converge and modifications were introduced in the subsequent models with a view of optimizing parsimony and achieving convergence.

All analyses were carried out in Stata v12.1 and we used an alpha level of 5% throughout.

RESULTS

General characteristics of the practices are presented in Table 1. According to the NHS Patient Register, the number of patients registered with the practices in this study during the study period was 54,299,945 (mean number of patients per practice: 7,084 (standard deviation (SD) = 4,144).

[TABLE 1 ABOUT HERE]

Cronbach's α and confirmatory factor analysis loadings indicated adequate internal consistency and structural validity of all the nine final domains (Table 2).

[TABLE 2 ABOUT HERE]

The matrix of correlations between the domains is shown in the Table 3. The highest correlations were observed for the pairs "patient-centered care" and "patient satisfaction" ($r=0.88$), "clinical management" and "intermediate outcomes" ($r=0.69$), and "medicine management" and "education and training" ($r=0.67$). The highest correlation coefficient for "health status" was with "patient satisfaction" ($r=0.05$) and "patient-centered care" (-0.05).

[TABLE 3 ABOUT HERE]

Figure 1 shows the results of the final model used to examine the associations between the quality domains (confidence intervals available in Table 4). The 137 observed variables provided 9590 variances and covariances, and the model estimated contained 432 parameters with 9158 degrees of freedom. We report standardized coefficients, which can be interpreted as standard regression coefficients and that allow for direct comparison (e.g. a one

SD increase in “education and training” is associated with a 0.32 SD increase in “clinical management”, but with a smaller 0.09 SD increase in “patient-centered care”).

[TABLE 4 ABOUT HERE]

According to the magnitude of the standardized coefficients, the model suggested two distinct paths. In the first path, “access to the practice” was associated with “patient-centered care” ($\beta=0.63$), which in turn was strongly associated with “patient satisfaction” ($\beta=0.88$). In the second path, “education and training” was associated with “clinical management” ($\beta=0.32$), which in turn was strongly associated with “intermediate outcomes” ($\beta=0.70$). These two paths were substantially independent, with weak associations between “clinical management” and “patient-centered care” ($\beta=0.08$), and between “clinical management” and “patient satisfaction” ($\beta=0.05$). Finally, “health status” was weakly associated with “patient-centered care” ($\beta=-0.05$), and “patient satisfaction” ($\beta=-0.09$), but not with “clinical management” or “intermediate outcomes”.

[FIGURE 1 ABOUT HERE]

The chi-squared test indicated that the model performed significantly poorer than the saturated model (likelihood ratio test of model vs. saturated: $\chi^2(9158)=296452.6$, $\text{Prob}>\chi^2 = 0.000$). However this test is sensitive with very large sample sizes and alternative measures (SRMR and RMSEA, with values of 0.07 and 0.06 respectively) indicated adequate model fit (Steiger 1990). This was however not supported by the comparative fit index (0.58), with a value below the recommended 0.9. The coefficient of determination for the whole model (with similar interpretation to R-squared) was 0.99.

Equation level goodness of fit statistics showed that the model explained a high proportion of variability in “patient satisfaction” (R-squared =78%), “intermediate outcomes” (48%), and “patient-centered care” (42%). However the model performed less well for “clinical management” (13%) and “health status” (0.3%).

Only one of the five alternative models considered successfully converged. The results from this alternative model (available in Online Appendix 3) generally supported our main findings, observing positive associations between “structure of care” (derived from indicators from the sub-domains “quality assurance”, “education and training” and “medicine management”) and “clinical management”, which in turn was associated with “intermediate outcomes” and with “patient experience” (derived from indicators from “access to practices”, “patient centeredness”, and “patient satisfaction”). Self-reported health was not associated with patient experience or with intermediate outcomes.

DISCUSSION

In this study we used a structural equation model to examine the network of associations between multiple domains of the quality of healthcare provided in family practices in England. We identified two independent paths. The first path links access to practices to patient-centered care and to patient satisfaction. The second path links education and training to clinical management of care and to intermediate outcomes. Patient reported health status was very weakly associated with patient-centered care and patient satisfaction, and not associated with clinical management or intermediate outcomes.

Strengths and limitations

This study has a number of strengths. It includes data for the great majority of QMAS practices in England (covering over 99% of patients). In addition it simultaneously examines the association between multiple domains of healthcare quality by using robust analytic methods and a large number of evidence-based indicators which rely on information provided both by clinicians and patients. But some limitations need to be taken into account. First, the cross-sectional nature of this study makes causal inference problematic. Reversed associations are implausible in most of the cases, but not always (e.g. we hypothesized intermediate outcomes to affect patient satisfaction, but inversed causality is also plausible as more satisfied patients could be more adherent to treatment recommendations, which could result in better intermediate outcomes). Future research using longitudinal designs is needed to better model causal effects. Second, following established recommendations (Hays and White 1987) we considered a number of alternative structural equation models to better understand the associations between the different domains of quality of healthcare tested in our main model. However only one of them could be successfully estimated (which generally supported our main findings), and we cannot rule out the possibility of other alternative

models leading to a different interpretation of our data. Third, our study was restricted to practice-level analysis and did not allow us to draw conclusions about patient-level associations. Practice level analysis, however, is of inherent interest and can inform relevant aspects such as resource allocation and primary care configuration. Four, data for this study was obtained from two different sources, and each quality domain was based on information from only one of them. This could have resulted in an overestimation of the magnitude of the associations between domains from the same source, and an underestimation of the associations from different sources. Fifth, although we used established measures of family practice quality in England, some limitations intrinsic to both sources may have affected our findings. Concerns relating to a low response rate and low reliability have been raised with respect to the GPPS. However, there is little evidence that low response rates have introduced bias (Campbell et al. 2009), and research shows that most survey questions used in this study meet stringent guidelines for reliability (Lyrtatzopoulos et al. 2011). QOF indicators measure only a fraction of the healthcare provided by a practice to their patients, and the analysis of other (non-incentivized) activities might yield different results. Finally, the model did not include practice characteristics such as deprivation or size that have been previously associated with performance. A decision was made not to include those additional variables to facilitate model convergence. Similarly, it would have been desirable to include in the model hospital admissions or mortality rates, but this information was not readily available.

Interpretation of results and implications for health services organization

The first path suggests that patients' ease of access to their practice is associated with patient-centered care, and that patient satisfaction is higher in those practices with higher levels of patient-centered care. The observed relationship between access and patient-centered care may suggest that, by enhancing access, practices may create a platform from which to

develop opportunities for a partnership between patient and clinicians that accounts for the patient's position and feelings. This would support the idea of prioritizing resources for improving access to family practices. The observed relationship between patient-centered care and patient satisfaction has been reported previously (Kinnersley et al. 1999; Lewin et al. 2001) and has strong face validity. A recent patient level study including more than 2 million patients responding to the GP Patient Survey observed that doctor communication was the most important patient experience factor driving satisfaction (Paddison et al. 2015).

The second path identified suggests that practices with higher levels of training and education are better equipped to deliver high quality clinical care, having a more positive impact on intermediate health outcomes. This finding has strong face validity, and supports the clinical aspects that are incentivized as part of QOF scheme in the UK. In addition, it highlights the importance of adequate training, identifying it as a priority area for resource allocation. Interestingly however, although the education and training provided to healthcare professionals was associated with better clinical management, its association with patient-centered care was very weak. This suggests that current training initiatives might have a very strong clinical orientation, in line with observations from previous research (Tsimtsiou et al. 2007). An increased focus on patient-centered education (which could be achieved for example by involving patients in training programs, which have shown to produce sustained gains in levels of interpersonal skills (Greco, Brownlea, and McGovern 2001)), may represent an opportunity of quality improvement worth exploring.

We observed a weak positive association between clinical management and patient-centered care and satisfaction, which was stronger in our alternative model. Previous studies analyzed the relationship between clinical management and patient experiences in primary care settings, reporting findings ranging from no association (Gandhi et al. 2002; Chang et al. 2006; Rao et al. 2006) to modest positive associations (Schneider et al. 2001; Sequist et al.

2008; Llanwarne et al. 2013). Studies in secondary care reported moderate (Lehrman et al. 2010) or strong (Jha et al. 2008; Isaac et al. 2010; Stein et al. 2014) positive associations. The positive association observed in our study does not support the idea that encouraging doctors to concentrate on technical aspects of care, incentive schemes such as the QOF will lead to deterioration in the doctor-patient relationship, or vice versa.

Unexpectedly, medicine management was negatively associated with clinical management. Although it may be hypothesized that adequate medicine management may be resource consuming and it may occur at the expense of high quality processes of care, there is little evidence to support such a view. We are therefore unable to explain the observed association, and more research is needed to confirm this inverse relationship and eventually elucidate the mechanisms by which it might operate.

Although patient-reported outcome measures have been traditionally regarded as a measure of need rather than performance, in recent years there has been a growing interest in their use for performance assessment of the health system and for benchmarking and quality improvement purposes in healthcare organizations (Nelson et al. 2015). In our study, self-reported health status was very weakly associated with patient-centered care, and we observed no association with clinical management or intermediate outcomes. Similar findings were observed in our alternative model. Our findings are consistent with a previous study which observed no association between patients' baseline assessments of the quality of primary care they received and subsequent changes in health-related quality of life and survival (Mold et al. 2011). However this contrasts with previous primary care specific studies supporting a link between primary care supply and positive perceived health (Shi et al. 1999; Shi and Starfield 2000; Shi and Starfield 2001). More specifically it has been observed that good primary care experience, in particular enhanced accessibility and continuity, is associated with better self-reported health both generally and mentally (Shi et

al. 2002). A number of aspects need to be taken into account when interpreting the lack of association observed in our study. First, the fact that we used self-reported health status aggregated at the practice level may have reduced our ability to detect a potential association. An individual patient receiving good quality of primary healthcare is more likely to have better health outcomes than a patient receiving poor primary healthcare. However the same does not necessarily apply at the practice level, as measures of population health are more likely to be influenced by environmental and social factors. Second, the potential impact of processes of care on health outcomes is likely to occur in a longer period of time than, for example, the impact of processes of care on patient satisfaction or intermediate outcomes. The cross-sectional nature of our study thus hindered our ability to examine this specific relationship. Finally, it is well known that health status is correlated with multiple factors beyond the GP's control. This include genetic variation (it has been estimated that one-third of the variability of self-reported health can be attributed to genes (Romeis et al. 2000)), but also by other personal, social, economic, and environmental factors (Dahlgren and Whitehead 1991), which were not included in our study. Therefore a hypothetical small effect such as the one described by Shi et al. (2002) cannot be ruled out by the findings of this study because of the methodological constrains described above. Although we think our model is of relevance in reflecting the status of the healthcare system, we acknowledge that it may be of more limited value in reflecting health.

Self-reported health status was weakly associated with patient satisfaction, which supports previous research from the hospital setting (Hays et al. 2006). An inverse association may be plausible in this case (more satisfied patients could have higher adherence to treatment recommendations and therefore have better health outcomes), and has been observed in a previous longitudinal study (Marshall, Hays and Mazel 1996). However we tested this inverse association in our alternative model, observing that patient experience was

not associated with self-reported health. Our results might reflect that patients with poorer health constitute a particular group of primary care service users not only in respect of above-average service use, but also in respect of the range and type of services used, particularly reflective of lower levels of overall satisfaction with healthcare services. This is in line with a recent study observing that patients with multimorbidity more frequently report worse experiences in primary care (Paddison et al. 2015). This could have implications for quality improvement initiatives, as segmenting the patient population by their medical needs could enable patients' feedback to indicate where quality improvements are required for specific groups. Other industries have been successful in understanding where to make improvements for consumers through data segmentation techniques that identify specific groups within the population (Flott et al. 2016).

Conclusion

By including an unprecedented number of factors within a single statistical model, this study was able to describe the network of associations between multiple domains of quality of healthcare provided in Primary Care in England. This is the first empirical model simultaneously providing evidence on the independence of all intermediate health care outcomes, patient satisfaction, and health status. The explanatory paths via technical quality clinical management and patient centeredness offer specific opportunities for the development of quality improvement initiatives. Further longitudinal and patient level studies are needed to confirm our findings.

REFERENCES

- Alazri, M. H. and R. D. Neal. 2003. "The association between satisfaction with services provided in primary care and outcomes in Type 2 diabetes mellitus." *Diabetic Medicine* 20(6): 486-90.
- Bollen, K. A. 1989. *Structural Equations with Latent Variables*. New York: Wiley & Sons.
- Brooks, R. 1996. "EuroQol: the current state of play." *Health Policy* 37(1): 53-72.
- Bull, A. 1994. "Specifying quality in health care." *Journal of Management in Medicine* 8(2): 5-8.
- Campbell, J., P. Smith, S. Nissen, P. Bower, M. Elliott, and M. Roland. 2009. "The GP Patient Survey for use in primary care in the National Health Service in the UK--development and psychometric characteristics." *BMC Family Practice* 10: 57.
- Campbell, S. M., M. O. Roland, and S. A. Buetow. 2000. "Defining quality of care." *Social Science and Medicine* 51(11): 1611-25.
- Chang, J. T., R. D. Hays, P. G. Shekelle, C. H. MacLean, D. H. Solomon, D. B. Reuben, C. P. Roth, C. J. Kamberg, J. Adams, R. T. Young, and N. S. Wenger. 2006. "Patients' global ratings of their health care are not associated with the technical quality of their care." *Annals of Internal Medicine* 144(9): 665-72.
- Cooperberg, M. R., J. D. Birkmeyer, and M. S. Litwin. 2009. "Defining high quality health care." *Urologic Oncology* 27(4): 411-6.
- Dahlgren, G., and M. Whitehead. 1991. *Policies and strategies to promote social equity in health*. Stockholm: Institute for future studies.

Donabedian, A. 1966. "Evaluating the Quality of Medical Care." *The Milbank Memorial Fund Quarterly* 44(3): 166-206.

Donabedian, A. 1980. *The Definition of Quality and Approaches to Its Assessment*: Health Administration Press.

Doyle, C., L. Lennox, and D. Bell. 2013. "A systematic review of evidence on the links between patient experience and clinical safety and effectiveness." *BMJ open* 3(1).

Evans, D. B., T. T. Edejer, J. Lauer, J. Frenk, and C. J. Murray. 2001. "Measuring quality: from the system to the provider." *International journal for quality in health care: journal of the International Society for Quality in Health Care* 13(6): 439-46.

Fenton, J. J., A. F. Jerant, K. D. Bertakis, and P. Franks. 2012. "The cost of satisfaction: a national study of patient satisfaction, health care utilization, expenditures, and mortality." *Archives of Internal Medicine* 172(5): 405-11.

Flott, K.M., C. Graham, A. Darzi, E. Mayer. 2016. Can we use patient-reported feedback to drive change? The challenges of using patient-reported feedback and how they might be addressed. *BMJ quality & safety* doi: 10.1136/bmjqs-2016-005223. [Epub ahead of print]

Gandhi, T. K., E. C. Francis, A. L. Puopolo, H. R. Burstin, J. S. Haas, and T. A. Brennan. 2002. "Inconsistent report cards: assessing the comparability of various measures of the quality of ambulatory care." *Medical Care* 40(2): 155-65.

Gardner, K. and D. Mazza. 2012. "Quality in general practice - definitions and frameworks." *Australian Family Physician* 41(3): 151-4.

Greco, M., A. Brownlea, J. McGovern. 2001. "Impact of patient feedback on the interpersonal skills of general practice registrars: results of a longitudinal study". *Medical Education* 35(8): 748-56.

Goodwin, N., A. Dixon, T. Poole, and V. Raleigh. 2011. Improving the quality of care in general practice. Report of an independent inquiry commissioned by The King's Fund. London: The King's Fund.

Harteloh, P. P. 2003. "The meaning of quality in health care: a conceptual analysis." *Health care analysis : HCA : journal of health philosophy and policy* 11(3): 259-67.

Hays, R.D., K. White. 1987. "The importance of considering alternative structural equation models in evaluation research". *Evaluation & the health professions* 10(1):90-100.

Hays, R.D., J.A. Eastwood, J. Kotlerman, K.L. Spritzer, S.L. Ettner, M, Cowan. 2006. "Health-related quality of life and patient reports about care outcomes in a multidisciplinary hospital intervention". *Annals of behavioral medicine: a publication of the Society of Behavioral Medicine* 31(2):173-8.

Health and Social Care Information Centre. 2015. "Indicator Portal". [accessed on January 13, 2016]. Available at: <http://www.hscic.gov.uk/indicatorportal>

Howie, J. G., D. Heaney, and M. Maxwell. 2004. "Quality, core values and the general practice consultation: issues of definition, measurement and delivery." *Family Practice* 21(4): 458-68.

Hoyle, R. H. 1995. Structural Equation Modeling: Concepts, Issues and Applications. London: Sage Publications.

Isaac, T., A. M. Zaslavsky, P. D. Cleary, and B. E. Landon. 2010. "The relationship between patients' perception of care and measures of hospital quality and safety." *Health Services Research* 45(4): 1024-40.

Jha, A. K., E. J. Orav, J. Zheng, and A. M. Epstein. 2008. "Patients' Perception of Hospital Care in the United States." *New England Journal of Medicine* 359(18): 1921-31.

Kinnersley, P., N. Stott, T. J. Peters, and I. Harvey. 1999. "The patient-centredness of consultations and outcome in primary care." *The British journal of general practice : the journal of the Royal College of General Practitioners* 49(446): 711-6.

Kline, R. B. 2015. *Principles and Practice of Structural Equation Modeling*. New York: Guilford Publications.

Kocher, R., E. J. Emanuel, and N. A. DeParle. 2010. "The Affordable Care Act and the future of clinical medicine: the opportunities and challenges." *Annals of Internal Medicine* 153(8): 536-9.

Kontopantelis, E., M.O. Roland, and D. Reeves. 2010. "Patient experience of access to primary care: identification of predictors in a national patient survey". *BMC Family Practice*, 11, 61.

Lehrman, W. G., M. N. Elliott, E. Goldstein, M. K. Beckett, D. J. Klein, and L. A. Giordano. 2010. "Characteristics of hospitals demonstrating superior performance in patient experience and clinical process measures of care." *Medical care research and review: MCRR* 67(1): 38-55.

Lewin, S. A., Z. C. Skea, V. Entwistle, M. Zwarenstein, and J. Dick. 2001. "Interventions for providers to promote a patient-centred approach in clinical consultations." *The Cochrane Database of Systematic Reviews* (4): Cd003267.

Llanwarne, N. R., G. A. Abel, M. N. Elliott, C. A. Paddison, G. Lyratzopoulos, J. L. Campbell, and M. Roland. 2013. "Relationship Between Clinical Quality and Patient Experience: Analysis of Data From the English Quality and Outcomes Framework and the National GP Patient Survey." *Annals of Family Medicine* 11(5): 467-72.

Lohr, K. N., M. S. Donaldson, and J. Harris-Wehling. 1992. "Medicare: a strategy for quality assurance, V: Quality of care in a changing health care environment." *QRB Quality Review Bulletin* 18(4): 120-6.

Lyratzopoulos, G., M. N. Elliott, J. M. Barbieri, L. Staetsky, C. A. Paddison, J. Campbell, and M. Roland. 2011. "How can health care organizations be reliably compared?: Lessons from a national survey of patient experience." *Medical Care* 49(8): 724-33.

Marshall, G.N., R.D. Hays, R. Mazel. 1996. "Health status and satisfaction with health care: results from the medical outcomes study". *Journal of consulting and clinical psychology* 64(2):380-90.

Mead, N. and P. Bower. 2002. "Patient-centred consultations and outcomes in primary care: a review of the literature." *Patient Education and Counselling* 48(1): 51-61.

Mold, J. W., F. Lawler, K. J. Schauf, and C. B. Aspy. 2012. "Does patient assessment of the quality of the primary care they receive predict subsequent outcomes? An Oklahoma Physicians Resource/Research Network (OKPRN) study." *Journal of the American Board of Family Medicine : JABFM* 25(4)e1-e12.

Nelson, E. C., E. Eftimovska, C. Lind, A. Hager, J. H. Wasson, and S. Lindblad. 2015. "Patient reported outcome measures in practice." *BMJ (Clinical research ed.)* 350.

Paddison, C.A., G.A. Abel, M.O. Roland, M.N. Elliott, G. Lyratzopoulos, J.L. Campbell. 2015. Drivers of overall satisfaction with primary care: evidence from the English General

Practice Patient Survey. *Health expectations : an international journal of public participation in health care and health policy* 18(5):1081-92.

Paddison, C. A., C. L. Saunders, G. A. Abel, R. A. Payne, J. L. Campbell, M. Roland. 2015. "Why do patients with multimorbidity in England report worse experiences in primary care? Evidence from the General Practice Patient Survey". *BMJ Open*, 5(3), e006172.

Prescribing and Primary Care team, Health and Social Care Information Centre. 2012. "Quality and Outcomes Framework, Achievement, prevalence and exceptions data, 2011/12" [accessed on January 13, 2016] . Available at:

<http://www.hscic.gov.uk/catalogue/PUB08135/qof-11-12-rep.pdf>

Rao, M., A. Clarke, C. Sanderson, and R. Hammersley. 2006. "Patients' own assessments of quality of primary care compared with objective records based measures of technical quality of care: cross sectional study." *BMJ (Clinical research ed.)* 333(7557): 19.

Roland, M. 2004. "Linking physicians' pay to the quality of care--a major experiment in the United kingdom." *New England Journal of Medicine* 351(14): 1448-54.

Romeis, J.C., J.F. Scherrer, H. Xian, S.A. Eisen, K. Bucholz, A.C. Heath, J. Goldberg, M.J. Lyons, W.G. Henderson, and W.R. True. 2000. "Heritability of self-reported health." *Health Services Research* 35(5): 995–1010.

Safran, D. G., D. A. Taira, W. H. Rogers, M. Kosinski, J. E. Ware, and A. R. Tarlov. 1998. "Linking primary care performance to outcomes of care." *The Journal of Family Practice* 47(3): 213-20.

Schneider, E. C., A. M. Zaslavsky, B. E. Landon, T. R. Lied, S. Sheingold, and P. D. Cleary. 2001. "National quality monitoring of Medicare health plans: the relationship between enrollees' reports and the quality of clinical care." *Medical Care* 39(12): 1313-25.

Sequist, T. D., E. C. Schneider, M. Anastario, E. G. Odigie, R. Marshall, W. H. Rogers, and D. G. Safran. 2008. "Quality monitoring of physicians: linking patients' experiences of care to clinical quality and outcomes." *Journal of General Internal Medicine* 23(11): 1784-90.

Shi, L., B. Starfield, B. Kennedy, and I. Kawachi. 1999. "Income Inequality, Primary Care, and Health Indicators." *Journal of Family Practice* 48: 275 – 84.

Shi, L., and B. Starfield. 2000. "Primary Care, Income Inequality, and Self-rated Health in the U.S." *International Journal of Health Services* 30: 541 – 55.

Shi, L., and B. Starfield. 2001. "Primary Care, Income Inequality, and Racial Mortality in U.S. Metropolitan Areas." *American Journal of Public Health* 91 (8): 1246 – 50.

Shi, L., B. Starfield, R. Politzer, J. Regan. 2002. Primary Care, Self-rated Health, and Reductions in Social Disparities in Health. *Health Services Research* 37(3): 529–550.

Sizmur, S. 2012. "Composite domain markers for GPPS: analysis report." Oxford: Picker Institute Europe. [accessed on January 13, 2016] . Available at:

https://indicators.ic.nhs.uk/download/Patient%20experience/Specification/COMPOSITE_DO_MAIN_MARKERS_FOR_GPPS.pdf

Steffen, G. E. 1988. "Quality medical care: A definition." *JAMA* 260(1): 56-61.

Steiger, J. H. 1990. "Structural Model Evaluation and Modification: An Interval Estimation Approach." *Multivariate Behavioral Research* 25(2): 173-80.

Stein, S. M., M. Day, R. Karia, L. Hutzler, and J. A. Bosco. 2014. "Patients' Perceptions of Care Are Associated With Quality of Hospital Care: A Survey of 4605 Hospitals." *American journal of medical quality: the official journal of the American College of Medical Quality* 30(4):382-8.

Tsimtsiou, Z., O. Kerasidou, N. Efstathiou, S. Papaharitou, K. Hatzimouratidis, and D. Hatzichristou. 2007. "Medical students' attitudes toward patient-centred care: a longitudinal survey." *Medical Education* 41(2): 146-53.

Winefield, H. R., T. G. Murrell, and J. Clifford. 1995. "Process and outcomes in general practice consultations: problems in defining high quality care." *Social Science and Medicine* 41(7): 969-75.

Table 1. Characteristics of General Practices included in the study (N=7,607)

	Mean (SD)	Range
Number of registered patients	7,084 (4144)	597; 44,071
Female	50.37 (5.59)	20.28; 75.47
Age (%)		
18-24 years	9.83 (5.66)	0; 86.17
25-34 years	17.49 (8.19)	0; 70.07
35-44 years	18.43 (5.20)	0; 44.87
45-54 years	18.32 (4.11)	0; 37.42
55-64 years	15.02 (4.43)	0; 32.92
65-74 years	11.20 (4.25)	0; 28.44
75-84 years	6.95 (2.99)	0; 21.56
≥85 years	2.75 (1.61)	0; 11.62
Race (%)		
White	84.24 (21.90)	0; 100
Black	3.26 (6.54)	0; 64.13
Asian	8.25 (14.61)	0; 93.56
Index of multiple deprivation*	23.52 (12.08)	2.86; 66.38

*McLennan et al. 2011. The English Indices of Deprivation 2010: Technical Report. 2011.

Table 2. Characteristics of the healthcare quality domains considered

	Source	Number of indicators	Cronbach's α†	Confirmatory factor analysis (loadings range)
Education and training	QOF	6	0.72 (0.67; 0.72)	0.47; 0.65
Medicines management	QOF	8	0.84 (0.80; 0.85)	0.35; 0.87
Quality assurance	QOF	16	0.86 (0.85; 0.86)	0.30; 0.76
Access to the practice	GPPS	8	0.92 (0.90; 0.92)	0.49; 0.99
Clinical management	QOF	70	0.94 (0.93; 0.94)	0.07; 0.63
Patient-centered care	GPPS	12	0.97 (0.96; 0.97)	0.64; 0.97
Patient satisfaction	GPPS	2	0.96 (NA)	0.95; 0.96
Intermediate outcomes	QOF	9	0.81 (0.77; 0.81)	0.39; 0.74
Health status	GPPS	5	0.92 (0.88; 0.93)	0.39; 0.74

† Mean (minimum; maximum); QOF, quality and outcomes framework; GPPS, GP Patient Survey; NA: Not applicable

Table 3. Correlations between the healthcare quality domains

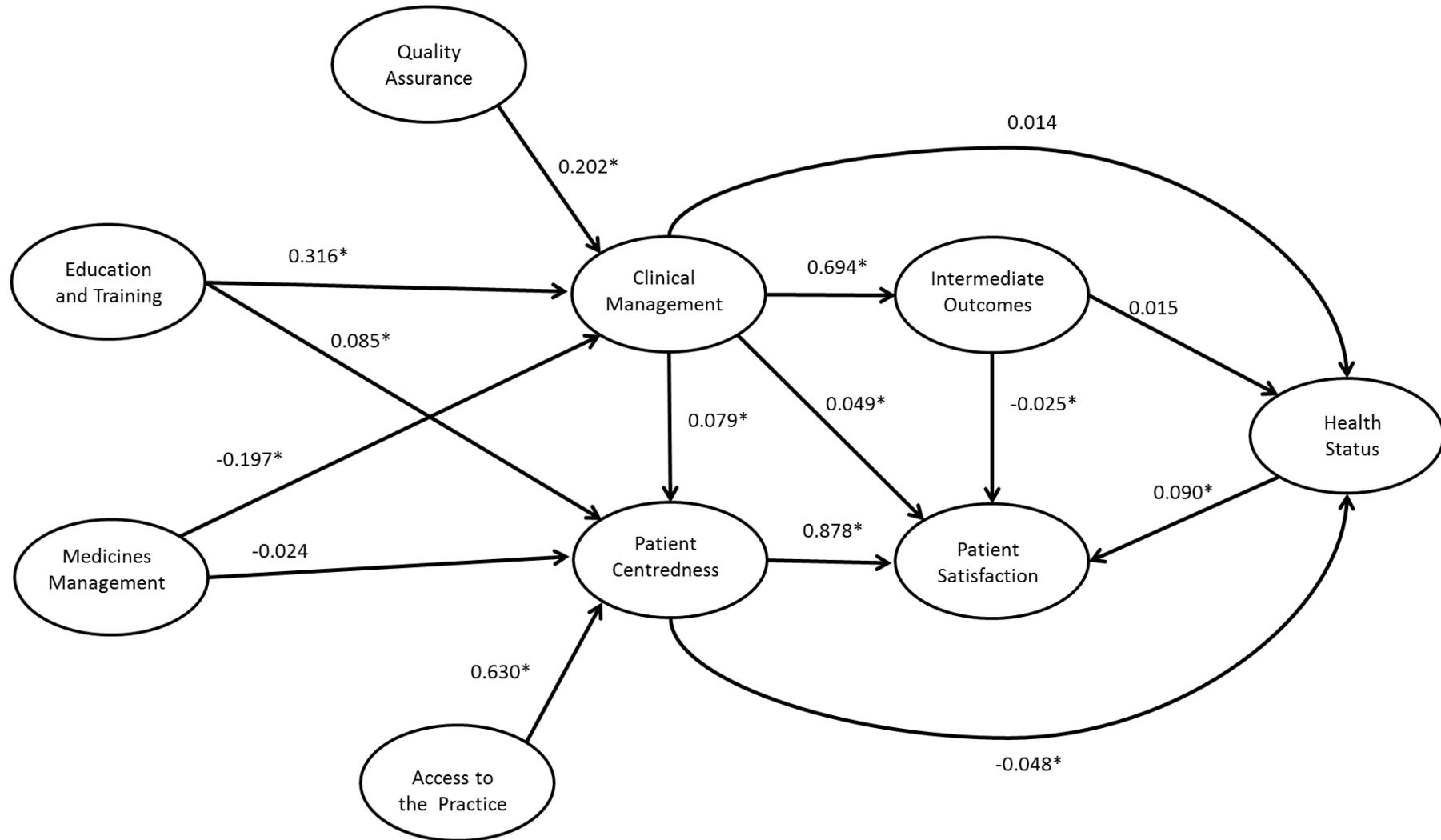
	Quality assurance	Education and Training	Medicines Management	Access to the practice	Clinical management	Patient-centred care	Intermediate Outcomes	Patient Satisfaction	Health Status
Quality assurance	1	0.634	0.605	0.026	0.284	0.078	0.197	0.078	0.003
Education and Training	0.634	1	0.670	0.026	0.313	0.110	0.217	0.107	0.021
Medicines Management	0.605	0.670	1	0.018	0.138	0.056	0.095	0.053	0.001
Access to the practice	0.026	0.026	0.018	1	0.010	0.632	0.067	0.553	-0.030
Clinical management	0.284	0.313	0.138	0.010	1	0.109	0.694	0.129	0.019
Patient-centred care	0.078	0.110	0.056	0.632	0.109	1	0.076	0.878	-0.045
Intermediate Outcomes	0.197	0.217	0.095	0.067	0.694	0.076	1	0.077	0.020
Patient Satisfaction	0.078	0.107	0.053	0.553	0.129	0.878	0.077	1	0.051
Health Status	0.003	0.021	0.001	-0.030	0.019	-0.045	0.020	0.051	1

Table 4. Associations between healthcare quality in the final structural equation model.

Structural Effect/ Path coefficient	β	95 % CI	
Patient-centered care to Patient satisfaction	0.878	0.872	0.885
Clinical management to Intermediate outcomes	0.694	0.678	0.709
Access to practice to Patient-centered care	0.630	0.616	0.644
Education and training to Clinical management	0.316	0.272	0.360
Quality assurance to Clinical management	0.202	0.166	0.238
Medicines management to Clinical management	-0.197	-0.236	-0.158
Health status to Patient satisfaction	0.090	0.077	0.103
Education and training to Patient-centered care	0.085	0.052	0.118
Clinical management to Patient-centered care	0.079	0.060	0.099
Clinical management to Patient satisfaction	0.049	0.030	0.068
Patient-centered care to Health status	-0.048	-0.071	-0.024
Intermediate outcomes to Patient satisfaction	-0.025	-0.045	-0.006
Medicines management to Patient-centered care	-0.024	-0.053	0.006
Intermediate outcomes to Health status	0.015	-0.024	0.053
Clinical management to Health status	0.014	-0.023	0.050

β , standardized coefficients; CI, confidence interval

Figure 1. Associations between healthcare quality and health outcome domains. Results from the final structural equation model.



Statistically significant associations ($p < 0.05$) are noted with an asterisk (*).