

Using an electronic PROMs system in UK chiropractic practices: Routinely collecting outcomes and costs.

Abstract

Objectives: *This study sought to collect a number of valid and widely used health outcomes, including information concerning cost of care using a web based patient driven PROs collection process within a cohort of UK chiropractic practices.*

Methods: *Care Response, a web based Patient Reported Outcomes (PROs) collection system was used. Patients with low back and neck pain were recruited within a cohort of UK based chiropractic practices and provided demographic data together with generic and condition specific PROs at the initial consultation and 90 days later with the addition of a patient reported experience measure (PREM) and additional health seeking in order to estimate costs of care.*

Results: *A cohort of 33 clinics recruited a total of 1895 patients that completed baseline questionnaires with 844 completing the 90-day follow up. Subsequent outcomes as categorised according to a number of methodologies suggest over 70% of patients improved over the course of treatment regardless of outcome used. Using the baseline as a virtual counterfactual we calculated QALYs and the cost thereof resulting in a mean QALY gained of 0.8 with an average cost of £895 per QALY.*

Conclusion: *We argue that routine collection of PROMs, including cost is possible and desirable and can be achieved using an on line system within the chiropractic practice environment. Further work and debate as to the standardisation of PROMs used, analysis and presentation of subsequent data appropriate for the the chiropractic profession and patients is required before the profession can fully engage in this mainstream activity.*

Introduction

Measuring health is important. Drivers concerning the legitimacy of health care interventions in the context of outcomes and cost have changed considerably over the last 2 decades and traditional measures are increasingly accompanied or superseded entirely with the use of patient reported outcomes (PROs) utilising patient reported outcome measures (PROMs). The notion of collecting patients' opinions about the services they receive and the influence these data can have on future healthcare policy has gathered increasing momentum with PROM collection becoming more common within routine clinical care settings, and increasingly so as part of national health care provision^{1, 2, 24} In the UK, the government white paper '*Equity and Excellence: Liberating the NHS*' highlighted the importance of health outcomes and preceded a fundamental shift by the UK government in how healthcare was to be evaluated; moving from process targets (e.g. waiting times and bed availability) to improvement in clinical outcomes, particularly as self-reported by patients³.

Black⁴ cites the routine collection of PROs as an opportunity to drive changes in delivery and organisation of health care and suggests a number of key strategies for successful future implementation. He suggests that these include the need to encourage adoption of new data collection technologies and the imperative to make use of the opportunity that PROMs presents to develop value based care in which health services can be driven by health outcomes per pound spent.

In the US, such 'value for money' models are represented increasingly by Value Based Purchasing (VBP) whose advocates argue could provide better health, better care and lower costs with some suggesting such approaches as potentially transforming health care delivery.⁵ A key requirement of such an approach includes concise core sets of patient-centred measures that encompass health gains, health care, and cost metrics and that these are collected routinely within the care setting.

In order to evidence such a role within the environment of mainstream healthcare such routine and widespread collection of outcomes and cost, as expounded by these progressive ideas are an imperative for the chiropractic profession. In this context and given the huge impact of MSK conditions on both society⁶ and healthcare budgets, the chiropractic profession has a potentially significant role to play in providing care that can be robustly and reliably shown to have impact on patients in every day clinical practice⁷.

Despite the availability of appropriate musculoskeletal PROMs, and generic healthcare measures that could allow direct comparison with health outcomes achieved with other health conditions the collection of such important data within the chiropractic profession is still in its infancy. Whilst there are a number of RCTs⁸ that have addressed cost effectiveness of chiropractic care there is little information linking costs and outcomes of care in large cohorts, which more readily represent routine chiropractic practice.

This study therefore sought to implement a web based patient driven PROs collection process within a cohort of UK chiropractic practices. We sought to collect a number of valid and widely used health outcomes, including information concerning cost of care and in reflecting on the process, provide guidance as to how PROMs and cost data might routinely be gathered and reported. Lastly, we provide an argument for the widespread and routine use of PROMs collection within the chiropractic profession.

Methods

Study Design

The study design was a prospective, single cohort, multi-centre observational study.

Participating clinics

Clinics were recruited from the British Chiropractic Association (BCA) membership in the UK. Recruitment was achieved through the use of articles and flyers included in regular BCA produced publications and at the association's conference in March 2013. This included attendance by 2 of the study team who approached attendees of the conference and collected contact information from those that indicated interest. Clinicians already using the system outside of this study were also approached by e mail and telephone and recruitment continued throughout the study duration.

Patients

Patients consulting participating clinics consented to take part in the study on line in the initial assessment phase. In addition to consent, there were three other eligibility criteria; a valid email address, access to the Internet, 17 years old and over and low back or neck pain as indicated on a body image that constituted part of the on line system. Patients, who either voluntarily presented to a

chiropractic clinic or were referred by their GP, completed a range of metrics before their first appointment and at 90 days follow up.

Web based PROM system

Dissemination of PROMs was on an automated basis via an on line delivery/collection system; Care Response (CR) (<https://www.care-response.com/CareResponse/home.aspx>). This system generates e-mails containing embedded links at set time points during the course of patient care, automatically sending these links to patients registered on the system. The initial link is sent by clinic staff, prior to the patients' appointment and directs patients to assessment questions, which can be completed on any device that has access to emails, e.g. PCs, Tablets or smartphones.

An automated follow-up assessment is then e mailed to the patients at 90 days after their initial appointment. Once the patient completes the assessment, data are stored and collated on an encrypted server using bespoke software. This system is presently being used by a number of manual therapy based practitioners in the UK. However for this study we modified the generic system to collect additional data including a baseline question concerning workday's missed and 90-day follow-up questions concerning additional treatments outside of chiropractic care and patient experience of care.

Baseline and Follow-up instruments

Bournemouth Questionnaire (BQ)⁹⁻¹³

The BQ is a validated condition specific outcome consisting of seven 11-point numerical rating scales (0-10) each measuring a different aspect of the back pain experience. These are pain, disability in activities of daily living, disability in social activity, anxiety, depression, fear avoidance behaviour and locus of control. Subscales are summed to produce a total BQ score (maximum of 70). BQ data was collected pre initial visit and at 90 days follow up.

Patient Global Impression of Change (PGIC)¹⁴

The Patient Global Impression of change is a single question followed by 7 potential responses. Using the (PGIC) scale, patients are asked 'How would you describe your pain/complaint now, compared to how you were when you completed the questionnaire before your first visit to this clinic?' The scale ranges from 1 (very much worse) to 7 (very much improved). PGIC data was collected pre initial visit and at 90 days follow up.

EQ5D^{15,16}

This measure is a standardized health-related quality of life questionnaire and provides a generic measure of health⁵ generating a descriptive profile and a single index value for health status that can be used in the clinical and economic evaluation of health care. EQ5D5L data were collected by redirecting during patient completion of PROMs to the Euroqol website (<http://www.euroqol.org/>). This data was collected pre initial visit and at 90 days follow up.

Patient reported experience measure (PREM)

Patient experience of care is used to measure the degree of patient centeredness of a consultation¹⁷. In this study patients were asked to rate their experience on 5 domains as very good, good, don't know and very poor. These domains consisted of: Advice on self-management, satisfaction with care, involved in decision-making, explanation and enough time. This was a modification of a previously developed PREM¹⁸ with the addition of the two further domains of satisfaction and self-management. This data was collected at the 90-day follow up point.

Analysis

Descriptive statistics and appropriate inferential comparison were made between initial assessments and follow up for BQ change scores and an ordinal Patient Global Impression of Change (PGIC) outcome. BQ change scores were calculated using the following equation $((\text{follow up score} - \text{baseline score}) / 100)$. These change scores were categorised into those that experienced deterioration (<0% change), small (0-15% change), moderate (16-30% change) and clinical (>30% change), deemed as an acceptable minimal clinical important change¹⁹. PGIC scores were collapsed into 3 categories for the purpose of this study with patients indicating very much, much and minimally worse, being categorised as 'worse', those indicating no change and minimal improvement as 'none or minimal' and those indicating much and very much improved as 'improved'.

The EQ-5D utility score was calculated using the Euroqol societal weightings tables that convert the 5 digits generated by each of the EQ5D domains into a single figure. This continuum goes from 1, perfect health, through 0, death, to -0.5, worse than death²⁰ Using the EQ5D data we calculated Quality-Adjusted Life Years (QALYs) as the change in EQ5D index scores from baseline to 90 day follow up multiplied by the estimated length of effect^{21,47} In addition, EQ5D individual domain change scores were a calculated as recommended by Euroqol¹⁶

In addition a Paretian method was employed to determine the proportion of patients that fell into 1 of 4 categories according to Devlin et al²². These categories were determined from the raw 5 digit EQ5D scores at baseline and 90 days follow up and consisted of, no change (pre-post health profiles are the same), follow up profile is better than the baseline profile (better in at least 1 dimension and not worse in any other), follow up profile is worse than the baseline profile (worse in at least one dimension and not better in any other), mixed change (worse and better in at least 2 dimensions)

Results

Clinic characteristics

During the course of the data collection, a total of 33 clinics were recruited with all but one collecting at least 1 complete data set. Clinics recruited were predominantly located in the south of England and of these, the majority were in a single county (Figure 1). The number of full data sets collected by this one county comprised over two thirds (66%) of the total sample.

Patient characteristics

In total, 3779 patient details were entered onto the web based PROMs collection system from clinics agreeing to participate in the study, throughout fieldwork. The flow of patients and attrition throughout the study is shown in Figure 2. There were 844 patients who completed both the baseline and the follow-up assessment, giving a final response rate of 45%. This response rate was bolstered by telephone follow up reminders after 90 days.

Baseline characteristics of the sample are described in Table 1. Generally there were more females than males with a mean age of the cohort of 45(13) years (range: 17–70). Approximately two-thirds of respondents were in paid employment (68%) and presented with chronic pain (60%) with only a small proportion (6%) on sick leave. The majority (64%) were experiencing a reoccurrence in their painful episode.

There were a significant number of patients who completed the baseline assessment but did not complete the 90-day follow-up. To explore any bias, responder and non-responder baseline data were analysed. In all variables, other than gender, there were no significant differences between these two groups.

Patient Reported Outcome Measures (PROMs)

Figure 3 shows the categorisation of BQ percent change scores. Over three quarters (78%) of patients achieved clinically significant improvement as determined by a >30% change in BQ scores at follow up. However, around 10% deteriorated over the course of care.

Using categorised Patient Global Impression of Change scores, 77% of patients indicated improvement, with only 4% indicating deterioration (Figure 4). As might be expected, those patients who reported improvement on the PGIC also reported the largest improvement in BQ change score (mean reduction of 74%). Patients who felt worse had a negative BQ change score of 10% and those experiencing no change reported a mean reduction of 14%.

EQ5D scores as categorised using the Paretian method showed similar responses to both BQ and PGIC measures in that greater than 73% of patients improved and around 10% worsened (Figure 5). An analysis of the EQ5D domains indicated that the majority of change reported improvement in self-care, activities, pain and mobility (Figure 6). There was very little change in anxiety, which as expected was low to start with at baseline.

Patient Reported Experience Measures (PREMs)

The feedback concerning patient's experience of key aspects of care was overwhelming positive (Figure 7). Over 90% of patients in all domains on care experience thought the chiropractor 'good' or 'very good' with particularly high scores on advice for self-management.

Cost analysis

The mean number of chiropractic appointments patients received was 5.4 (SD = 2.9, range = 1-20 visits) during the 90-day period. Thirty percent of patients had more than six visits during the 90-day period, which accounted for nearly half of all the individual chiropractic appointments.

An analysis of the cost of care during the 90-day period is shown in Table 2. The mean total cost of direct care was £258 per patient, while the indirect mean cost of workdays lost was only £38 leading to a total mean cost of care of around £300. Of the direct costs, chiropractic consultations, as expected, were the most significant contributor, accounting for around 68% of total costs. Most other costs including diagnostic scans, medical procedures and visiting other health care professionals mostly constituted at most around 4% as individual items.

On average, around 0.8 QALYS were gained over the 90-day period with a mean cost per QALY (including work absenteeism) of £845 (Table 3) although there was a large variation around this mean figure. Figure 8 also illustrates this variation as the distribution of QALYs gained against cost with apparent clustering around 0.5 or 1.5 QALYs gained but large costs variation associated with such gains. Secondary analysis indicates that these 2 clusters broadly represent those patients that had not or had achieved a minimal clinical change in the BQ scores.

Discussion

This study implemented a web-based method for the collection of PROMs and PREMs in chiropractic practice. The following discussion explores the choice and reporting of measures used and the rationale for the use of such measures and collection approach on a routine basis across the chiropractic profession as a whole.

Why collect PROs?

In 2008, the UK government published the report 'High Quality Care for All' which identified a major role for measuring outcomes as assessed by patients themselves, i.e. PROMs (Patient Reported Outcome Measures) ²³ and proposed to make self-reported measures a key strategy to secure

improvements in the quality of care in the NHS. The rationale for this approach is centered on the idea that if you wish to understand if an individuals' health status has improved it seems self evident that you might ask the individuals themselves. This push for routine collection of data as seen from the patients' perspective is not unique to the UK with calls for such approaches being made in other developed health care systems²⁴. Measuring the quality of healthcare is a central concern in an era where the ability to provide more health care alone does not necessarily improve outcomes²⁵ where without the collection of outcomes only quantity, not quality of health would be discernable.

In this respect then, the collection of PROMs within the chiropractic profession has considerable potential to positively inform and impact clinical and policy domains, including assessing relative clinical quality, auditing clinical services and informing clinical decision-making^{26, 27}. In addition to these professional and process benefits, evidence also suggests that involving patients in the monitoring of their condition using PROMs might generate other significant benefits. In the context of a drive to put the patient at the center of their care and emerging priorities such as secondary prevention and self-management of chronic conditions additional benefits of PROMs collection include; increased self-management of chronic conditions²⁸, patient empowerment and shared decision-making^{29, 30}, increased compliance to treatment goals³¹ and early detection of deterioration or adverse changes³².

Despite that chiropractic care is not universally reimbursed across developed nations the issue of cost is key in raising the profile of the professions impact on MSK conditions. A prescient model recently launched in the UK illustrates the type of innovation that may underpin such eventual funding and inclusion of chiropractic care in the NHS. In this scheme MSK services were provided by a consortium of providers and paid for by a Care Commissioning Group, (CCG), the regional payers in the UK system. Of the money provided, around £25 million per year over a 5 year period, 5% of this payment (approx. £200,000 per annum) was dependent on outcomes measured, including the use of 5 quality criteria; innovative use of technology, integrated care, improved patient outcomes, quality of patient experience, production of an annual report³³. The results of this endeavour are yet to be reported but such a pilot represents one of the first pay by outcomes trials in the UK and it is the authors contention that the UK chiropractic profession should position itself in terms of PROMs collection to take advantage of any further expansion of central government funding for independent sector healthcare provision.

Collecting PROs in practice

Given the persistent and convincing case concerning, the collection of health data such as PROs it is likely this activity will become the ubiquitous across healthcare settings²⁴. Interestingly and somewhat preempting formal collection of such data within healthcare organisations is the emergence of routine health data acquisition by smart phones, wearable devices and other innovative methods of monitoring patient status. This digital phenomenon increasingly pervades human experience on a global scale and its integration into health care service assessment and provision is likely to be substantial^{34, 35}.

The potential of web based and mobile technologies for collecting health data augurs fundamental changes in the way clinicians interact with patients and it holds promise for addressing problems typically associated with clinical data collection in busy clinical environments. Such perceived and real barriers include the disruptive impact of logistic and administrative processes inherent paper-based methods³⁶, lack of infrastructure and knowledge or confidence³⁷ and in the independent sector, clinician anxieties concerning the potential to interfere with care and at worst, deter patients from returning by impacting patient experience (Newell, Bolton and Diment: unpublished data). However, the use of web based patient completed data collection as completed by the patient may ameliorate many of these concerns and this study supports the feasibility of such collection on line in chiropractic clinics. Similar web based data collection has been trialled in both primary care and home settings^{39, 40} and while there have been some problems in uptake³⁸ these methods are likely evolve and improve. Further

development may see an extension of these approaches to mobile technology and while the experience of the very few trials using such methods to collect PROs is mixed at present⁴¹⁻⁴³ they potentially hold much promise for service provision assessment generally and care as delivered by the chiropractic profession in particular.

Choosing PROMs

In the context of MSK conditions such as low back pain considerable progress has been made in defining a core outcome set for use within clinical trials but as yet this process is still ongoing and may provide limited advice as to the types of measures appropriate for routine data collection⁴⁴

Despite this, consensus is emerging that PROMs should include patient experience, functional status, and costs, particularly in the context of a value based purchasing approach⁵. In terms of functional status both condition specific and generic measures are available and we chose to use the Bournemouth Questionnaire, a well established and psychometrically characterised.⁹⁻¹³ back and neck outcome measure and the EQ5D, a generic quality of life measure that includes functional status, pain and psychological domains¹⁶

The EQ5D has been extensively developed and widely used including as part of the PROMs initiative in the UK for measuring elective surgery outcomes and is set to be extended across primary care settings in the near future with early pilot studies showing promise⁴⁵ The EQ5D can be reported in a number of ways²² but most often is associated with cost analysis. We carried out such an analysis by transforming 243 potential individual health states into indexes using a time trade off method¹⁶ and multiplying this by the estimated time of the effect to generate a QALY gained⁴⁶ Arguably this moves the measure outside of that purely reported by the patient as national populations views are used to generate summary figures. In addition how one determines the length of time is problematic as typically this was in terms of life threatening disease and 10 years life expectancy was traditionally used. Devlin⁴⁶ suggests using a time period that represents the likely period of effect, for example 15 years for the typical hip replacement. This judgment is problematic for low back pain and neck pain in that it is unclear how long any impact of chiropractic care lasts and the precise nature of reoccurrence. In this study we took the arbitrary decision to use the 25% reoccurrence rate per year as reported by Stanton et al⁴⁷, extrapolating this to 4 years for the length of time resolution of LBP may last without treatment. However, this includes an assumption that the pre treatment QALY will stay the same without treatment and for hip degeneration it is most likely to decline and therefore underestimate health benefits gained. However, for low back pain and neck pain there is a high likelihood of improvement over time in a significant proportion of cases. Thus health improvements and any costs thereof are likely to be overestimated and considerable caution is needed in interpreting such data. On the other hand, comparing health gained and cost between alternative approaches each determined by single cohort studies, one might expect this phenomena to be similar where demographic, practice and condition based factors are similarly comparable. In this case data may well provide useful information in choosing and/or funding alternate approaches including providing information for patients themselves.

Despite the EQ5D enabling standard comparator values, there remains a question as to adequate sensitivity when used for low severity and often self-resolving condition like low back and neck pain¹⁸ Lastly, licenses were purchased to allow the PROM collection software to re route patients to the Euroqol website as this measure is not freely available. Clearly there are cost implications then to collecting this data and these would require consideration in any widespread and routine collection of this PROM in the chiropractic context.

Additional to specific and generic PROMs, the assessment of patient experience through PREMs is increasingly considered to be key to a patient centred approach to health care provision. Ensuring patients have a positive experience of care is a central recommendation of the recent NHS outcomes

framework. There have been a number of measures such developed, for example the consultation and relational empathy measure (CARE) ⁵⁴ and the MSK specific measure developed by Picker Institute⁴⁸ However, as both of these PREMs were 10 or more questions in length we created a shorter PREM while still retaining key aspects common to other measures. Consequently a previously developed set of 3 questions was used¹⁸ with the addition of questions concerning satisfaction and advice on self-management. While this was deemed to cover important issues of experience, a wider debate as to which domains for patient experience should be measured, particularly within the chiropractic context

Presenting PRO data

Summarising and reporting of data collected via PROMs is a central consideration in order to provide meaningful summaries to clinicians, patients and commissioners of healthcare⁴⁹, with reporting procedures strongly impacting the endorsement or rejection of therapies by third party payers or government health plans⁵⁰

Traditionally comparative studies have used change scores to determine the degree of improvement over time. However, more clinically interpretable measures such as ratios (RR/OR) and numbers needed to treat (NNT) have become commonplace and recommended. In observational studies such as service provision assessment, appropriate categorization of measures has the potential to provide straightforward and easy to interpret outcomes. Global measures such as the Patient Global Impression of Change have been extensively used provide the means for categorization of patients into improved, static and worsened groups. A similar approach can also be used for condition specific measures such as the BQ using values including MCID and quality of life (QoL) measures such as EQ5D using a Paretian classification²² This approach can facilitate a more direct comparison between these outcomes. In this study for example very similar proportions of patients improved regardless of the measure used and while this is not surprising as these measures share similar question domains, an exploration of additional PROMs that may capture unique information over and above that provided by BQ, PGIC and the EQ may be useful.

In summary, guidance as to appropriate measures for routine PROM and PREM collection tailored to the chiropractic profession and patient population is yet to be finalised. However, despite limitations in all measures, generic QoL outcomes, such as EQ5D, condition specific measures and a PREM are likely to encompass a utilitarian set of appropriate PROMs.

Limitations of this study

While the intention of this study was orientated toward the implementation of a web based PROM collection process and an exploration of the methods and metrics used to describe outcomes collected and not an attempt to describe outcomes and cost of care as associated with treatment, there are clear limitations to this study.

Firstly, these data were collected from a narrowly focused geographical area in the UK and it is possible that this sample may not be representative of either the characteristics or outcomes of the chiropractic low back and neck pain population as a whole.

Secondly, lack of any counterfactual makes assigning any treatment effects to the care given inappropriate. Given that low back pain often resolves due to natural history and that regression to the mean are likely to be present improvements seen, and subsequent costs of health gained could equally be due to these factors as the care given and this limits the use of cost outcomes analysis⁵¹ In terms of cost analysis it is therefore entirely possible that for some patients improvement may have been

achieved entirely free of charge in terms of treatment costs, although any other healthcare or absenteeism costs would still be applicable

Lastly, the choice of PROMs and categorisation points in the measures used are somewhat arbitrary, particularly the estimated effect of treatment over time for QALY calculations. Further debate is needed concerning such choices and this is an important prerequisite for any widespread and routine PROMs collection within the profession.

The future

In the UK and other developed health care sectors health providers are increasingly tasked with making difficult decisions in an attempt to increase quality of care while driving down cost. In this process health payers are turning to hard data to inform their decisions and in this respect. In this respect routine PROMs collection within the chiropractic profession would provide robust and relevant information with which to make such decisions.

The routine collection of outcomes is not currently part of state funded MSK care as delivered predominantly by hospital-based physiotherapy. In this context engagement with contemporary methods of collecting PROMs widely across the profession in a coordinated and consistent manner could see the chiropractic profession position itself at the forefront of innovative clinical and professional best practice. In addition, the collection of large epidemiological datasets using digital approaches hold the promise of identifying patient characteristics and clinical patterns that may inform both more effective intervention and more cost-effective approaches to MSK management.⁵²

Furthermore, outside of the clinicians needs, clearly the benefits for patients of collecting PROMs lie in a number of potential areas. For example there is emerging evidence that patient engagement with such monitoring can provide empowerment and a sense of control and partnership with the clinician. More straightforwardly, by auditing patient outcomes, adverse events and satisfaction with care received, care and clinical processes can be noted, reflected upon and potentially improved.

Uniquely in the UK, this study indicates that routinely collecting patient reported outcomes using a web based approach in the clinical environments of chiropractic clinics is achievable and that this can generate a diversity of valid and robust information that can be used by patients, clinicians, politicians and health care payers alike. The chiropractic profession has developed the skills and engagement to be potential partners in emerging models of MSK care as envisaged by health care systems challenged by increasing demand and shrinking or targeted resourcing. As such it is essential that the profession engage with mainstream initiatives one of which is the routine collection of clinical outcomes data clinical data. Given that other similar professions such as physiotherapy are urging the routine collection of PROMs⁵³ it is imperative that the chiropractic profession is not left behind.

This will take political drive, a relevant and convincing rationale and some degree of cultural change within the profession. We would suggest this is not an option but an imperative. One, that while presenting challenges, would position the profession as a relevant, contemporary and progressive player in the wider health care system.

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References

1. Devlin N, Appleby J. Getting the most out of PROMS, putting health outcomes at the heart of NHS decision-making. The King's Fund 2010. Available at: <http://www.kingsfund.org.uk/sites/files/kf/Getting-the-most-out-of-PROMs-Nancy-Devlin-John-Appleby-Kings-Fund-March-2010.pdf>
2. Patient Experience. Patient Reported Outcome Measures: Their Role in Measuring and Improving Patient Experience. July 2012. Available at: <http://patientexperienceportal.org/article/patient-reported-outcome-measures-their-role-in-measuring-and-improving-patient-experience#reference-8>
3. Department of Health (2010a). Equity and Excellence: Liberating the NHS. London: Department of Health: Available at: NHS England (20 December 2013). Every Contact Counts: Planning for Patients 2014/15 – 2018/19 Available at: <http://www.england.nhs.uk/wp-content/uploads/2013/12/5yr-strat-plann-guid-wa.pdf>
4. VanLare, J.M. & Conway, P.H., 2012. Value-based purchasing--national programs to move from volume to value. *The New England journal of medicine*, 367(4), pp.292–295.)
5. Black N. Patient reported outcome measures could help transform healthcare. *BMJ*. 2013 Jan 28;346(jan28 1):f167–7.
6. Murray CJL, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012 Dec 15;380(9859):2197–223.
7. Brown R. A health care system in transformation: making the case for chiropractic. *Chiropractic & Manual Therapies* [Internet]. 2012 Jan 1;20(1):37. Available from: <http://>
8. Clar C, Tsertsvadze A, Court R, Hundt GL, Clarke A, Sutcliffe P. Clinical effectiveness of manual therapy for the management of musculoskeletal and non-musculoskeletal conditions: systematic review and update of UK evidence report. *Chiropr Man Therap*. 2014;22(1):12.
9. Bolton JE, Breen AC. The Bournemouth Questionnaire: a short-form comprehensive outcome measure. I Psychometric properties in back pain patients. *J Manipulative Physiol Ther* 1999; 22:503-10
10. Bolton J, Humphreys B. The Bournemouth Questionnaire: a short-form comprehensive outcome measure. II. Psychometric properties in neck pain patients. *J Manipulative Physiol Ther* 2002; 25: 141-148
11. Hurst H., Bolton J. Assessing the clinical significance of change scores recorded on subjective outcome measures. *J Manipulative Physiol Ther* 2004; 27(1): 26–35.
12. Bolton J. Sensitivity and specificity of outcome measures in patients with neck pain: detecting clinically significant improvement. *Spine* 2004; 29(21): 2410–7
13. Newell D, Bolton J. Responsiveness of the Bournemouth questionnaire in determining minimal clinically important change in subgroups of low back pain patients. *Spine* 2010; 35(19): 1801–1806
14. Field J, Newell D. Relationship between STarT Back Screening Tool and prognosis for low back pain patients receiving spinal manipulative therapy. *Chiropractic & Manual Therapies* 2012, 20:17.
15. EuroQol Group T. (1990). EuroQol: a New Facility for the Measurement of Health-related Quality of Life. *Health Policy*.
16. Valuation of EQ5D. URL: <http://www.euroqol.org/about-eq-5d/valuation-of-eq-5d.html>
17. Hodson, M., Andrew, S. & Michael Roberts, C., 2013. Towards an understanding of PREMS and PROMS in COPD. *Breathe*, 9(5), pp.358–364.
18. Houweling, T (2013) Description of outcomes, patient experiences and related costs of care in low back pain patients undergoing chiropractic treatment in the UK. PhD thesis, University of Portsmouth. (Available at: <http://eprints.port.ac.uk/11824/>)
19. Gurden M, Morelli M, Sharp G, Baker K, Betts N, Bolton J. Evaluation of a general practitioner referral service for manual treatment of back and neck pain. *Primary Health Care Research & Development* [Internet]. 2012 Jul 1;13(03):204–10. Available from: http://www.journals.cambridge.org/abstract_S1463423611000648

20. Franco S. Calculating QALYs, comparing QALY and DALY calculations. *Health Policy Plan.* (2006) 21 (5): 402-408
21. Devlin N, Krabbe P. The development of new research methods for the valuation of EQ-5D-5L. *Eur J Health Econ* (2013) 14 (Suppl 1):S1–S3.
22. Devlin, N.J., Parkin, D. & Browne, J., 2010. Patient-reported outcome measures in the NHS: new methods for analysing and reporting EQ-5D data. *Health Economics*, 19(8), pp.886–905.
23. Department of Health E. NHS Outcomes Framework 2012/13. 2011. http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_131700).
24. McGrail K, Bryan S, Davis J. Let's all go to the PROM: the case for routine patient-reported outcome measurement in Canadian healthcare. *HealthcarePapers.* 2010.
25. Fisher ES, Wennberg DE, Stukel TA, Gottlieb DJ, Lucas FL, Pinder ÉL. The Implications of Regional Variations in Medicare Spending. Part 1: The Content, Quality, and Accessibility of Care. *Ann Intern Med.* American College of Physicians; 2003 Feb 18;138(4):273–87.
26. Boyce, M. B., Browne, J. P., & Greenhalgh, J. (2014). The experiences of professionals with using information from patient-reported outcome measures to improve the quality of healthcare: a systematic review of qualitative research. *BMJ Quality & Safety*, 23(6), 508-518.
27. Boyce, M. B., & Browne, J. P. (2013). Does providing feedback on patient-reported outcomes to healthcare professionals result in better outcomes for patients? A systematic review. *Quality of Life Research*, 22(9), 2265-2278.
28. De Jong CC, Ros WJ, Schrijvers G. The effects on health behaviour and health outcomes of Internet-based asynchronous communications between health providers and patients with a chronic condition: a systematic review. *J Med Internet Res.* 2014 Jan 16;16(1)
29. Stiggelbout AM, Van der Weijden T, De Wit M P T, Frosch D, Légaré F, Montori VM, Trevena L, Elwyn G. Shared decision making: really putting patients at the centre of healthcare *BMJ* 2012;344
30. Clark N, Nelson B, Valerio M, Gong M, Taylor-Fishwick J, Fletcher M. Consideration of shared decision making in nursing: a review of clinicians' perceptions and interventions. *Open Nurs J.* 2009; 3: 65–75.
31. Newell D, Beyer R Increasing compliance towards home exercise in chiropractic patients using SMS texting: A pilot study. *Clinical Chiropractic Volume 15, Issues 3–4, December 2012, Pages 107–111*
32. Cleeland C, et al Automated symptom alerts reduce postoperative symptom severity after cancer surgery: a randomised controlled clinical trial. *Journal of Clinical Oncology.* Published online before print January 31, 2011
33. Van Tuykom B, Stoefs J. How the NHS is leveraging ICHOM's Standard Sets for value-based purchasing. Cambridge, MA: International Consortium for Health Outcomes Measurement (ICHOM); July 2014. (available at www.ichom.org)
34. Mosa, A., Yoo, I. & Sheets, L., 2012. A systematic review of healthcare applications for smartphones. *BMC medical informatics and.* Available at: <http://www.biomedcentral.com/1472-6947/12/67/?referrer=Baker>.
35. Swan, M., 2012. Health 2050: The Realization of Personalized Medicine through Crowdsourcing, the Quantified Self, and the Participatory Biocitizen. *Journal of Personalized Medicine*, 2(4), pp.93–118.
36. Boyce, M. B., Browne, J. P., & Greenhalgh, J. (2014). The experiences of professionals with using information from patient-reported outcome measures to improve the quality of healthcare: a systematic review of qualitative research. *BMJ Quality & Safety*, 23(6), 508-518.
37. Duncan, E.A. & Murray, J., 2012. The barriers and facilitators to routine outcome measurement by allied health professionals in practice: a systematic review. *BMC Health Services Research*, 12(1), pp.1–9.

38. Rolfson O, Salomonsson R, Dahlberg LE, Garellick G. Internet-based follow-up questionnaire for measuring patient-reported outcome after total hip replacement surgery—reliability and response rate. *Value Health* 2011;14:316-21.
39. My clinical outcomes. Helps patients and doctors manage long-term conditions. www.myclinicaloutcomes.co.uk.
40. PROMs 2.0. <http://proms2.org/default.html>.
41. Roberts N, Bradley B, Williams D. Use of SMS and tablet computer improves the electronic collection of elective orthopaedic patient reported outcome measures. *Ann R Coll Surg Engl*. 2014 Jul;96(5):348–51.
42. Palmen LN, Schrier JCM, Scholten R, Jansen JHW, Koëter S. Is it too early to move to full electronic PROM data collection? *Foot and Ankle Surgery*. 2015 May.
43. Wilson, J. et al., 2014. Patient-reported outcome measures: an on-line system empowering patient choice. *Journal of the American Medical Informatics Association : JAMIA*, 21(4), pp.725–729.
44. Chiarotto A, Terwee CB, Deyo RA, Boers M, Lin C-WC, Buchbinder R, et al. A core outcome set for clinical trials on non-specific low back pain: study protocol for the development of a core domain set. *Trials*. BioMed Central Ltd; 2014;15(1):511.
45. Peters M, Crocker H, Jenkinson C, Doll H, Fitzpatrick R. The routine collection of patient-reported outcome measures (PROMs) for long-term conditions in primary care: a cohort survey. *BMJ Open*. 2014;4(2):e003968.
46. Nancy J Devlin. Getting the most out of PROMs: health outcomes and NHS decision-making, Nancy Devlin and John Appleby, The King's Fund, March 2010. 2010 Mar 5;:1–92.
47. Stanton TR1, Henschke N, Maher CG, Refshauge KM, Latimer J, McAuley JH. After an episode of acute low back pain, recurrence is unpredictable and not as common as previously thought. *Spine (Phila Pa 1976)*. 2008 Dec 15;33(26):2923-8. doi: 10.1097/BRS.0b013e31818a3167.
48. Jenkinson C, Coulter A, Gyll R, Lindström P, Avner L, Höglund E. Measuring the experiences of health care for patients with musculoskeletal disorders (MSD): development of the Picker MSD questionnaire. *Scand J Caring Sci*. 2002 Sep;16(3):329–33.
49. Bolton JE. Future directions for outcomes research in back pain. *Eur J Chiropr*. 1997;45:57-64
50. Haywood KL. Patient-reported outcome I: measuring what matters in musculoskeletal care. *Musculoskeletal Care*. 2006;4(4):187-203.
51. Zarnke KB, Levine MAH, O'Brien BJ. Cost-Benefit Analyses in the Health-Care Literature: Don't Judge a Study by Its Label. *Journal of clinical epidemiology*. 1997;50(7):813–22.
52. Raghupathi, W. & Raghupathi, V., 2014. Big data analytics in healthcare: promise and potential. 2(1), pp.1–10.
53. Kyte, D, Calvert, M, Van Der Wees, P, Ten Hove, R, Tolan, S & Hill, J 2015, 'An introduction to patient-reported outcome measures (PROMs) in physiotherapy' *Physiotherapy*., 10.1016/j.physio.2014.11.003
54. Mercer SW, McConnachie A, Maxwell M, Heaney DH, and Watt GCM. Relevance and performance of the Consultation and Relational Empathy (CARE) Measure in general practice. *Family Practice* 2005, 22 (3), 328-334)

