





Original Article

Value-based healthcare in management of chronic back pain: A multidisciplinary- and lean-based approach

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ABSTRACT

Background: Chronic back pain stands as the most common musculoskeletal disorder and a primary cause of disability in people under 45 years old. Multidisciplinary consultation offers an efficient approach to chronic back pain management compared to traditional therapeutic-rehabilitative paths. This paper aims to show the benefit of a diagnostic-therapeutic multidisciplinary program pathway for patients with chronic back pain.

Methods: Twenty-six patients who underwent a second-level multidisciplinary consultation with a neurosurgeon and a pain therapist at our University Hospital were retrospectively identified from April 2023 to September 2023. The second-level multidisciplinary consultation is a second step consultation after a first consultation with a single specialist doctor (neurosurgeon, orthopedic, and pain therapist) who did not get the diagnosis and/or did not solve the painful symptom after medical or surgical treatment. Clinical outcomes, patient experience, and cost-effectiveness analysis were assessed using lean healthcare tools.

Results: With the introduction of second-level multidisciplinary consultation, patients were assessed by multiple physicians during a single visit, reducing the costs of individual visits, reducing the time to obtain the diagnosis, and facilitating early agreement on a diagnostic-therapeutic plan. The lean value-based healthcare approach showed an average of 45 working days lost per single patient and a total cost per single patient with chronic back pain of € 1069 for the national health system for an average Lead time of 18 months. Questionnaire analysis on service quality and utility, along with overall satisfaction, revealed excellent resolution of back pain in 53.8% of cases and partial resolution of back pain in 11.5% of cases after second-level multidisciplinary consultation.

Conclusion: Our multidisciplinary approach to chronic back pain has significantly improved healthcare efficiency. This new proposed clinical model reduces waiting times and costs and improves patient experience by improving clinical outcomes in the management of chronic back pain.

Keywords: Chronic back pain, Lean-based approach, Multidisciplinary management, Value-based healthcare

INTRODUCTION

For several years, the vision of lean-based production has been establishing itself as a system that best allows hospitals to achieve and maintain flexibility. In recent years, it has been seen that “doing Lean” is a necessity even in neurosurgery, as the primary objective of all hospitals is to guarantee the best clinical care in an increasingly modern, smart, and patient-friendly context.^[11,22,36] Value-based healthcare (VBHC) is based on a focus on eliminating waste and creating value for the patient by placing him at the center of the care process.^[6] This VBHC project adopted a lean organizational model that aims to simplify as much as possible the decision-making processes of diagnosis, therapy, and resolution of the painful symptom in patients with chronic back pain, taking into account the complexities of the hospital systems, based on a deep-rooted work culture oriented toward collaboration between the different operating units, allowing a truly multidisciplinary approach to the patient.^[9] VBHC is healthcare based on the value of care, that is to say, on the relationship between the real well-being of people and the costs incurred during the treatment cycle. Previous international experiences, both in Europe and in the United States, have shown that the VBHC model guarantees lower losses compared to paid services as well as offering better services and results. In addition, this model allows all stakeholders (patients and health-care facilities) to achieve the same goal: improving health-care outcomes in the most efficient way possible.^[12] Chronic back pain is the most frequent musculoskeletal disorder, the first cause of disability under 45 years of age, with an incidence of 50% in the over 60s.^[4,14,15,26] In the United States, direct spending on chronic back pain, including physician services, non-physician services, hospital admissions, and pharmacotherapy, is estimated to cost \$12.2–\$90.6 billion.^[8,18] However, if indirect costs are included, the total US cost attributable to chronic back pain could be as high as \$624.8 billion.^[8] In some cases, the cause of back pain can be easily associated with a single event or cause (degenerative disc disease, facet joint syndrome, and spondylolisthesis), but in most cases, chronic back pain is due to a combination of clinical, psychological, surgical, and/or traumatic events.^[2,23,32,36] The current situation shows how patients with complex chronic back pain carry out several diagnostic (X-rays, computed tomography [CT] scan, magnetic resonance imaging [MRI], and electrophysiological studies) and laboratory examinations (erythrocyte sedimentation rate [ESR], C-reactive protein [CRP], rheumatoid factor, and anti-nuclear antibodies), infiltrative treatments, radiofrequency, as well as the use of numerous anti-inflammatory drugs and pain killers.^[16,19,38] These patients often turn to different specialists at the same time or at a later time for the resolution of the painful symptom and the correct diagnosis without finding a solution to their problem.

Through the lean VBHC methodology, this paper aims to analyze the root causes and to identify the corrective measures for the management of patients suffering from complex chronic back pain through the creation of a second-level multidisciplinary consultation that combines the expertise of a neurosurgeon and a pain therapist in a single session for patients suffering from complex chronic back pain.

MATERIALS AND METHODS

Study population and multidisciplinary team

For this study, 26 patients (16 men and 10 women) who underwent at least 1 s-level multidisciplinary consultation with a neurosurgeon and a pain therapist at our University Hospital were retrospectively identified from April 2023 to September 2023. The mean age was 63.4 years, with 57.7% of patients older than 65 years. The multidisciplinary team included physicians from the Unit of Neurosurgery, Unit of Pain Therapy, Psychology, Lab Medicine, and Healthcare Management. The second-level multidisciplinary consultation is a second step consultation after a first consultation with a single specialist doctor (neurosurgeon, orthopedic, and pain therapist) who did not get the diagnosis and/or did not solve the painful symptom after medical or surgical treatment.

Root cause analysis

Root cause analysis was conducted using an Ishikawa diagram (also known as the cause-and-effect diagram or fishbone diagram). The first goal of root cause analysis is to discover the root cause of a problem or event. The second goal is to fully understand how to correct and remedy the underlying issues within the root cause, as well as to learn from them. Finally, the third goal is to apply what has been learned from this analysis to prevent future problems or achieve positive results again systematically.

Lean healthcare methodology and costs of individual services provided

The team strategically employed Lean methodologies, including insightful fishbone diagrams, which facilitated a comprehensive understanding of potential root causes. For each patient, the diagnostic-therapeutic background was analyzed from 2019 to 2023. Specifically, hospitalizations, surgeries, outpatient visits, laboratory services, and pharmacological prescriptions from ministerial computer flows were considered. Therefore, the following outpatient specialty and service medicine (radiology and laboratory) services inherent in the clinical problems of the patient with chronic spine and central nervous system pain were considered.

For the cost analysis, we identified and considered the outpatient specialist services included in the Tuscany Region's rates nomenclator, updated to July 2021. The fees for the main services provided by the Italian National Health System (NHS) to patients with chronic back pain and the relevant notes are shown in Table 1.

“Patients’ global impression of change (PGIC) scale” questionnaire

In the idea of the establishment of a shared pain therapy/neurosurgery second-level consultation and its activation, we thought, to assess the quality of the activated service, the use of a questionnaire that will be submitted to the patient with complex chronic pain called “Patients’ global impression of change (PGIC) Scale (modified),” to identify patient-centered outcomes: Patient-reported experience measures and Patient-reported outcome measures. All survey responses remained anonymous. The modified PGIC scale consists of six multiple-choice questions, as shown in Figure 1.

RESULTS

Using the Ishikawa diagram^[30], the root causes responsible for the failure to correctly manage chronic back pain at the outpatient level were identified. Figure 2 shows all the details. An analysis was conducted of the current situation related to the diagnostic-therapeutic pathway of patients diagnosed with complex chronic back pain. From the analysis of the root causes, it emerged that patients with complex chronic back pain have difficulty finding correct pain management, resulting in dissatisfaction with the caring experience. The patient is forced to multiple specialist consultations with

psychiatric, psychological, orthopedic, rheumatologic, neurosurgical, and pain therapy; several diagnostic tests; and attempts at therapy, sometimes inappropriate and inconclusive.

Before the establishment of the multidisciplinary second-level consultation, patients with chronic back pain underwent an average of 12.7 consultations, resulting in repeated accesses in health-care facilities with considerable stress and frustration due to misunderstanding and failure to reach the diagnosis.

By establishing a multidisciplinary team, the patient is evaluated by multiple professionals in a single access, avoiding waiting times and costs for individual visits and agreeing on the diagnostic-therapeutic scheme as early as possible. The diagnostic-therapeutic background was analyzed for each patient. During 2019–2023, a total of 4753 services were provided to these 26 selected patients. Among these 4753 services, 883 (18.6%) were assessed as related to chronic back pain. The most services provided by the Italian NHS to these patients were clinical pain consultation (follow-up) (67 total services performed), various chronic pain-specific laboratory tests (ESR, CRP, and autoantibodies) (152 total services performed), first orthopedic consultation (33), first clinical pain consultation (31), first neurosurgical consultation (29 total services performed), and analgesic treatment by infiltration (28). Figure 3 shows all the details.

During the period 2019–2023, a total of 4753 services were provided to these 26 patients by the Italian NHS for a total cost of about € 93499. The total cost of the 883 services (18.6%) assessed as related to chronic back pain was € 27798, divided into 330 specialist consultations (with an average of 12.7 services per single patient and an average unit cost per single patient of € 20); and 553 diagnostic and laboratory tests (with an average of 21.3 services per single patient and an average unit cost per single patient of € 37.8).

A subsequent analysis of direct and indirect costs showed a total expenditure on health per capita for chronic back pain of about € 1069, with an additional cost to the community, as this patient to undergo clinical consultations and perform diagnostic and laboratory tests, lost an average of 2.5 working days per single patient per single month, with an average of 45 working days lost per single patient for an average Lead time of 18 months, resulting in a total cost of € 11653 per single patient during that Lead time.

The quality of care received in the second-level multidisciplinary consultation for complex chronic pain was assessed by the PGIC modified scale, aimed at detecting the evolution of the patient's health and well-being status and assessing the quality of the service. The data collected were satisfactory [Table 2], as 30.8% and 19.2% of patients reported a decisive and good improvement in their pain

Table 1: Service costs provided to patients with chronic back pain by the Italian NHS.

Clinical exam/consultation	Cost (€)
Algologic consultation (follow-up)	€ 15,00
C-reactive protein (blood)	€ 4,00
ESR (blood)	€ 2,00
Neurosurgical/orthopedic first consultation	€ 22,00
Algologic/physiatric/rheumatologic first consultation	€ 22,00
Injection of anesthetic into the spinal canal for analgesia	€ 103,00
Psychological consultation	€ 19,00
Neurosurgical/orthopedic consultation (follow-up)	€ 15,00
MRI of the cervical, thoracic, or lumbar spine	€ 145,00
Spinal pacemaker checkup	€ 22,00
Infusion of other pharmaceutical substances	€ 4,00
CT scan of the cervical, thoracic, or lumbar spine	€ 21,00
EMG	€ 16,00
X-ray of the cervical, thoracic, or lumbar spine	€ 26,00
CT: computed tomography; EMG: Electromyography; MRI: Magnetic resonance imaging, ESR: Erythrocyte sedimentation rate; NHS: National health system	

1) Since you started treatment, can you describe your impression of how your pain condition has changed (limitation of physical activity, emotion and quality of life)?
No change (or even got worse)
Always the same, it is difficult to think of an improvement
A little better, but not remarkable
Moderately better, a slight and noticeable improvement
Better, which is a real difference
A big and decisive improvement, and making a difference
2) Please indicate the degree of change in your pain condition since the start of treatment:
Much worse
No change
Much better
3) Indicate the degree of change in pain between before and after the multidisciplinary outpatient visit:
Much worse
No change
Much better
4) How many working days did you (you or your caregiver) miss per month due to your condition (sick days, leave for visits/exams)?
0-1
2-3
4-5
More than 5
5) Since the beginning of your condition and before your involvement in the multidisciplinary pathway, how many consultations have you made for pain therapy?
1-2
3-4
More than 4
6) Since the beginning of your condition and before your involvement in the multidisciplinary pathway, how many diagnostic examinations have you performed (e.g. X-rays, CT scans, MRI scans, electromyography)?
1-5
6-10
More than 10

Figure 1: Patients' global impression of change scale (modified).

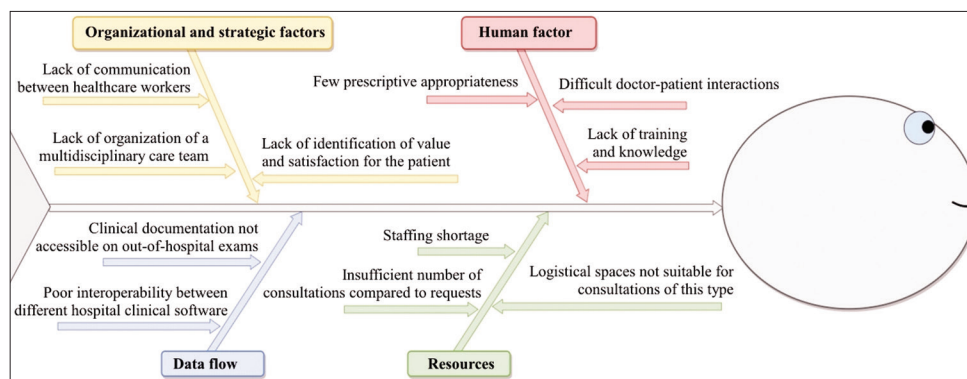


Figure 2: The Ishikawa diagram workflow shows all the possible root causes responsible for the failure to manage chronic back pain correctly.

condition after this multidisciplinary consultation, reporting an important change in the chronic back pain in 53.8% of

cases and partial resolution of the chronic back pain in 11.5% of cases.

Table 2: Survey results based on modified PGIC scale.

	<i>n</i> (%)
1) Since you started treatment, can you describe your impression of how your pain condition has changed (limitation of physical activity, emotion, and quality of life)?	
No change (or even got worse)	6 (23.1)
Always the same, it is difficult to think of an improvement	4 (15.4)
A little better but not remarkable	2 (7.7)
Moderately better, with a slight and noticeable improvement	1 (3.8)
Better, which is a real difference	5 (19.2)
A big and decisive improvement and making a difference	8 (30.8)
2) Please indicate the degree of change in your pain condition since the start of treatment:	
Much worse	10 (38.5)
No change	3 (11.5)
Much better	13 (50.0)
3) Indicate the degree of change in pain between before and after the multidisciplinary outpatient visit:	
Much worse	9 (34.6)
No change	3 (11.5)
Much better	14 (53.8)
4) How many working days did you (you or your caregiver) miss per month due to your condition (sick days, leave for visits/exams)?	
0–1	3 (11.5)
2–3	18 (69.2)
4–5	5 (19.2)
More than 5	-
5) Since the beginning of your condition and before your involvement in the multidisciplinary pathway, how many consultations have you made for pain therapy?	
1–2	-
3–4	2 (7.7)
More than 4	24 (92.3)
6) Since the beginning of your condition and before your involvement in the multidisciplinary pathway, how many diagnostic examinations have you performed (X-rays, CT scans, MRI scans, electromyography)?	
1–5	-
6–10	5 (19.2)
More than 10	21 (80.8)

PGIC: Patient's' global impression of change, CT: Computed tomography, MRI: Magnetic resonance imaging

DISCUSSION

Comprehensive multidisciplinary management of chronic back pain is a clinically effective and cost-effective approach when compared with non-multidisciplinary treatment, standard clinical care, and routine clinical consultation.^[7,10,33,37] Patients referred for multidisciplinary care are more likely to benefit from early diagnosis and treatment, as an early and accurate diagnosis is essential for

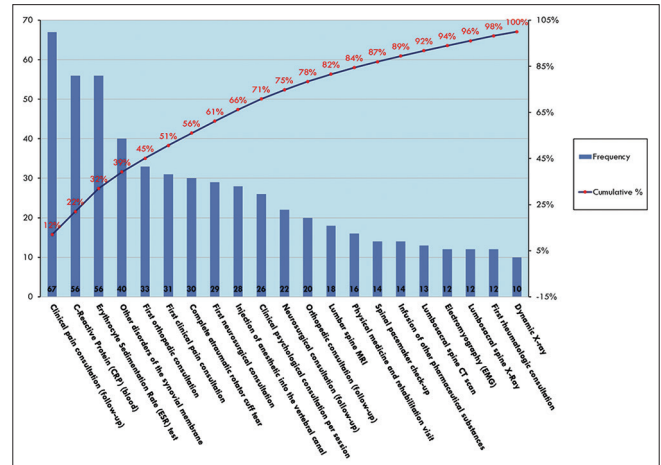


Figure 3: Diagram shows the most services provided by the Italian National Health System to these 26 patients with chronic back pain before the institution of a second-level multidisciplinary consultation with a neurosurgeon and a pain therapist.

several underlying conditions associated with chronic back pain.

Multidisciplinary pain management programs for patients suffering from chronic back pain include a variety of treatment modalities.^[25] Nees *et al.*^[25] reported a significant correlation between helpfulness ratings and sociodemographic data, indicating that patient-related factors influenced perceived treatment helpfulness and that the degree of pain-related improvements was affected by the patients' perceived treatment helpfulness. Moreover, inclusion within the team of health-care professionals from different medical specialties provides the patient with the opportunity to undergo a number of different treatment modalities (both pharmacological and nonpharmacological) specifically tailored to their needs.^[34] For the same reason, the NIH Guidelines for Research for chronic back pain papers were produced by a panel of experts (neurosurgeons, orthopedic surgeons, internists, rheumatologists, practitioners of manual therapies, and physical therapists) specifically chosen for the task.^[5,9,27] Surgical treatment or anti-inflammatory medical therapy can solve a good part of problems related to chronic back pain; however, some chronic back pains are too difficult to manage beyond primary care.^[13] Infiltrative treatments and radiofrequency can reduce or solve some chronic back pain, even if possible complications can also occur with these procedures and affect the costs of NHS.^[29,31,35] Clinicians at multidisciplinary pain clinics should have adequate infrastructure and tools to deal with such complex situations, which are not always available. The use of telemedicine also in spinal surgery can improve communication between colleagues, improving the quality of patient care; however, it presents limitations.^[3,20,24,28] All healthcare members of the multidisciplinary team should have appropriate knowledge

of both the basic sciences and clinical practices relevant to the management and treatment of chronic pain and be familiar with all relevant treatment guidelines. This ensures that, collectively, they can deal with a wide range of chronic pain types and that the treatment delivered is up-to-date, evidence-based, and safe. Furthermore, the appointment of a director or coordinator for the team to monitor the medical services provided ensures that high standards are maintained.^[17] The incorporation of ongoing research and academic teaching activities within a multidisciplinary pain program also contributes further to improving the quality of pain management; research activities enable advances to be made in scientific knowledge relating to pain, while educational activities provide the opportunity to disseminate relevant information to patients, health-care providers, and organizations.^[1,7,9,20,21]

The patient suffering from complex chronic back pain constitutes a complex challenge for the health-care system, as this kind of pain causes disability and often lack of self-sufficiency with high social and healthcare costs, as this paper showed. In an era in which it is increasingly difficult to support health-care spending financially, it is necessary to act in the direction of practices based on evidence of effectiveness, new technologies, and multi-professionalism, as well as to reorganize care systems, encouraging the integration of specialties and professionalism and abolishing the compartmentalized organization, to improve the quality of care.^[5]

Placing the patient at the center of this diagnostic path once they have crossed the threshold of the hospital produces value not only for the patient in terms of treatment and resolution of chronic back pain but also for the hospital and its staff. The creation of second-level multidisciplinary consultation for chronic back pain will allow an improvement in the diagnosis flows with a reduction in healthcare costs borne by the patient and the Italian NHS, a more rapid resolution of the painful symptoms, and the achievement of diagnosis, an improvement in multidisciplinary teamwork, clearer processes with a reduction in errors, requests for inconsistent and repeated diagnostic tests, and an improvement in the quality of service perceived by the patient and individual well-being.

CONCLUSION

This paper highlighted the importance of a lean VBHC methodology in the humanization of care and in terms of response times to therapy in patients with chronic back pain, showing how patients feel more understood regarding the painful symptom and reporting an excellent resolution of back pain in 53.8% of cases and partial resolution of back pain in 11.5% of cases after second-level multidisciplinary consultation. On the other hand, the lean VBHC methodology

showed the high waste of economic resources used and the collective costs supported by the Italian NHS for patients with chronic back pain, proposing the creation of a shared pain therapy/neurosurgery consultation as a measure to reduce money waste and time to reach the correct diagnosis.

Ethical approval

The Institutional Review Board approval is not required as it is survey and questionnaire based study.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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