

Are we prepared to implement a Lean philosophy within cancer-care service in Oman?

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ABSTRACT

الإدارة الإنسيابية كما تطبق في الإدارة ظهرت للدلالة على البساطة، والإستجابة السريعة، والكفاءة. المفهوم يرتبط بأن تفعل أكثر مع تكلفة أقل، أي استخدام الموارد بطريقة إنتاجية ممكنة من خلال القضاء على جميع أنواع الهدر. يمكن أن يتم تطبيق منهج الإنسيابية على أي مجال بما في ذلك الرعاية الصحية والتي ظهر فيها النمو الهائل للتكاليف على نطاق واسع. بدأت المستشفيات بتجربة الرعاية الصحية باستخدام الإدارة الإنسانية في المستشفيات والتي تتساوى فرص الحصول على الرعاية الصحية على المساواة مع مبادئ العدالة الإجتماعية وواجب المجتمع لضمان الرعاية الصحية الأساسية للجميع. ومع ذلك، فإن الفجوة بين المسؤولية الدستورية للدولة وتوافر الموارد آخذة في الاتساع، مما يخلق الحاجة إلى التطور في توفير الرعاية الصحية على أساس الملاءمة والموضوعية والنزاهة. ويجب على مقدمي الخدمات الصحية التوفيق الموارد المحدودة لضمان توافر الرعاية الصحية حتى للجميع في عصر انفجار التكلفة.

Lean, as it applies to business, has come to signify simplicity, swift response, and efficiency. The concept is to do more with less; namely, to use resources in the most productive way possible through the elimination of all types of waste. The Lean approach can be applied to any field, including healthcare, in which the exponential growth of costs is widespread. Hospitals began experimenting with Lean healthcare in 1990s. Equal accessibility to healthcare is consistent with the tenets of social justice and a society's duty to ensure basic healthcare to everyone. However, the gap between a state's constitutional responsibility and resource availability is widening, creating a need for an evolution in healthcare provision based on relevance, objectivity, and impartiality. Health-services providers must juggle limited resources to ensure even-handed healthcare availability to all in the era of cost explosion.

*Saudi Med J 2017; Vol. 38 (7): 691-698
doi: 10.15537/smj.2017.7.17712*

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The term Lean means thin, bearing a positive connotation. Thinness, as it applies here, is achieved by removing unnecessary complexity, in other words, extra weight. Similar principles can be observed in philosophies of artists and scholars throughout history, and they are well illustrated by the maxim attributed to Albert Einstein: "Everything should be made as simple as possible, but not simpler than that."¹ This principle has great applicability in the field of healthcare, with oncology being a prime example of a specialty that would benefit from a Lean approach.

The Lean management approach was introduced in the second half of the 20th century in the business sector. It was originally applied in automotive industry, but thanks to its flexibility and universal concepts, it was soon implemented in other fields, including healthcare. Currently, it is being adopted in various healthcare establishments throughout the world, and its results are widely reported as overwhelmingly positive.^{2,3} It is important to note that while the approach originated in Japan, the majority of case studies and theoretical support for its use in healthcare come from the US, United Kingdom, and Australia.⁴

Healthcare is driven by ceaseless demand, spurred equally by need and the principle of equal access to healthcare, which is woven into the fabric of modern societies. There is a constellation of factors that speak to the need for the implementation of Lean in healthcare. At the same time, ongoing advancements in technology and science lead to increasingly complex, ground breaking, and costly medical procedures.⁵ Also contributing to the challenge of healthcare provision is the phenomenon of an aging population, fundamentally a by product of improvement in health services, which, ironically, introduces additional strains on the system.⁶

Finally, while some traditionally intractable health issues have been resolved in recent years, the workload within healthcare has not diminished, because the range of responsibilities of healthcare providers has widened at the same time.

Preventive care and patient education are 2 examples of this: the potential patient benefits that preventive care and patient education provide is indisputable, and it would be natural to think that prevention and education would provide some workload relief for clinicians and nurses. However, in actual practice, preventive care and patient education require a reallocation of resources and budgets.⁷ So, in this arena, where the cost of the services inevitably rises, there is an inevitable conflict with the societal goal of universal accessibility, and these dynamics are almost self-perpetuating.⁸

The gap in healthcare access is among the most recognized consequences of unbridled advancements in healthcare in the developing World. There is a need for the field to evolve based on relevance, objectivity, and impartiality, and cost-effectiveness and health economics are integral to the evolution. Health services must juggle limited resources to ensure the even-handed provision of healthcare in an era of cost explosion.

This paper aims to examine the current state, scope, feasibility, preparedness, and acceptance of a Lean approach in cancer-care services in Oman.

An overview of Lean in cancer care. Oncology is among the most ripe medical branches for impact by Lean healthcare provision. Cancer has been associated for a long time with poor patient outcomes despite the best efforts of medical professionals, and it remains a priority in medical research throughout the world.⁹ Thus, the attention of stakeholders, most prominently, patients and doctors, was focused on the efficacy of treatment and the new, as well as potential, ways of addressing the disease. Understandably, the emergence of modern anti-cancer medications is always met with optimism by a hopeful public and covered with fanfare by the media. The high cost of such advances is briefly acknowledged at best or, more often, omitted entirely from the reviews. As a result, the public is generally unaware of the staggering costs until individuals, as patients, receive the jolting information in the oncology department. A similar situation can be observed in the medical literature. The majority of research focuses on the efficacy of treatment and patient outcomes, while budgeting issues, cost efficiency, and organizational issues are rarely scrutinized or evaluated. However, at least one paper acknowledges the systematic weaknesses in cancer care in Oman, which are grounded in structural and organizational issues pertinent to the field.¹⁰ In

essence, oncology is susceptible to accessibility gaps and the emergence of conditions leading to inequitable healthcare provision among patients of varying social and economic strata within Omani society, in addition to the elements that prevent the issues from surfacing, there is no progress on economic literacy, and the fiscal matters are compounded by the fact that ethical standards and comorbidities must be factored in.

As can already be seen, medical practices often function in isolation from economics. Effectiveness and efficiency of healthcare procedures are often stated as priorities; effectiveness is commonly measured by positive patient outcomes, and efficacy is considered fulfilled if ethics are maintained. Economic considerations are not apparent in explanation above, and they are rarely a factor in the decision-making process. Importantly, while economic sustainability, using available resources optimally, can be achieved through enhancing facility operations, it is also achievable by eliminating unnecessary operational steps and elements. Such an approach is notably consistent with the principles of Lean management.

Unnecessary elements, known in the Lean approach as waste, are abundant in the field of oncology, which is sufficiently diverse and multi-faceted to create management complications. The wastes in oncology can usually be categorized as organizational, procedural, and pharmacological. The organizational wastes usually consist of excessive traipsing among departments (on the part of clinicians during patient visits as well as patients), unduly long waits in lines, and uneven workloads (certain specialists are less in demand than others). Structural waste mostly consists of unnecessary or redundant scans and inappropriate issuing of antiemetic therapies. Finally, the pharmacological category is made up of unnecessary pre-medications (leading to adverse effects), wrongly prescribed costly drugs, and, in some cases, prescription of knowingly ineffective chemotherapy (for the sake of calming patients who otherwise feel neglected).

The oncology clinical practice often witness misuse of the available means. This indicates that there is a desperate need of a Lean approach, as depicted in **Figure 1**. In accordance with the “achieving more with less” principle, it is possible to create more consistent time- and cost-effective processes that will fundamentally reevaluate priorities, reallocate excess resources to the areas with the most demand and, ultimately, create a more efficient environment without sacrificing necessary components. The overall simplification made possible by applying Lean methods in oncology will result in the elimination of unnecessary therapies, combining those that are required into more efficient blocks of time, a

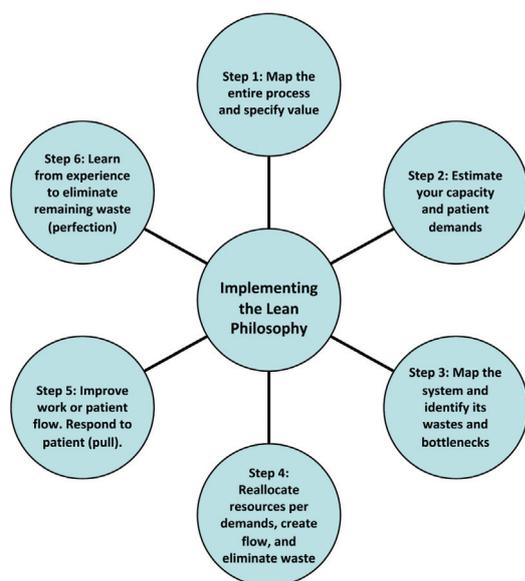


Figure 1 - Diagrammatic representation of process of lean implementation.

more automated, streamlined process flow, improved admissions processes and dispensing of medications, appropriate use of targeted therapy, and utilization of health technology assessment and integration.

Currently in Oman, healthcare providers do not routinely engage in the procedures mentioned above. Thus, to make sure that the interests of all stakeholders are assimilated, and that medical ethics and scientific and economic integrity are not compromised, it is necessary to implement the Lean philosophy in cancer-care services in Oman.

The State of Cancer Care in Oman. Annual reports by Oman's National Oncology Centre illustrate a steady rise in cancer incidence in Oman over the last decade. The emerging data shows an increase in cancer diagnosed cases with time.¹¹ According to a representative from Sultan Qaboos University Hospital, about one-third of the cases could be prevented by lifestyle changes, meaning that there are other factors responsible for the increase. First, cancer-care institutions have endeavored to raise public awareness of the disease, and these efforts are yielding results. Increased public awareness results in better understanding and higher report rates, improving the likelihood of timely interventions, but it leads to an increase in the cancer-patient population. More importantly, recent overall improvements in healthcare have led to an increase in life expectancy beyond the age of 70.¹¹ And because the chances of getting cancer increase significantly with age, it is logical

to expect that cancer-care institutions will be treating an increasing number of patients. Importantly, these factors are likely to persist, leading the World Health Organization (WHO) to predict that the cancer rate in the Eastern Mediterranean Region could double from 2012 to 2030.¹² Naturally, such a scenario necessitates the implementation of a Lean philosophy in cancer care in Oman to manage the rising demand without compromising efficacy, ethical standards or scientific integrity. The figure shows the possible steps in the process of incorporating Lean approach in cancer care services.

Types of waste. As mentioned earlier, Lean concepts are sufficiently universal that they transcend industries and enable us to conceive a preliminary list of waste types characteristic of cancer care in Oman.

Defects. This category is composed of a range of errors that are avoidable, preventable, and require performing a task a second time (non-value-added re-work). An easily understood example of this is the dispensing of mislabeled medication or unnecessarily admitting a patient for treatment that can be administered effectively on an outpatient basis due to issues of patient flow.

Logistics. On some occasions, walking distances between 2 consecutive treatment sites are unnecessarily long and avoidable. For example, a sample-collection site might be a long distance from a test lab, which puts unnecessary strain on already compromised patients.

Process interrupts. These types of pauses are common when clinicians and/or nurses need to search for missing or misidentified supplies, documents, and data.

Overproduction. This is the opposite of a bottleneck, typically occurring in a setting where the quick performance of one department leads to cluttering in subsequent stages. To understand this, consider a sample-collection site with exceptionally fast delivery of samples to a lab with slow processing times owing to the types of testing they do.

Overprocessing. This waste type involves ordering unnecessarily complex procedures when a more simple method would deliver the information sought. Ordering an MRI when a simple x-ray would suffice is an example of overprocessing.

Poor inventory management. This is characterized by a lack of coordination that would lead to medications out-lasting their shelf life and complication in accessing various pieces of equipment. By extension, poor inventory management results in unnecessary expenses.

Waste of human potential. This waste is brought about by not recognizing and strategically applying the skills, competencies, and initiative of staff members.

The list above is incomplete and may be expanded or altered upon further inquiry. However, it can be utilized in its present state for a broad implementation of Lean, because of the approach's flexibility and universal applicability. If the goal is to establish a Lean culture on an institutional level and address general and commonly present issues, an overview of the state of the industry will be sufficient. If, on the other hand, a more focused approach is required to implement Lean as a solution to a particular problem, additional analysis of the situation is recommended.

Tools for implementation of a Lean strategy. Different versions of Lean theory suggest a wide array of tools and methods for assessment and analysis, with the following being predominant:

Value stream mapping (VSM). The procedure consists of a fact-finding discussion followed by visual mapping of discovered issues, waste types, and the desired outcomes in accordance with the organization's vision. The resultant visual map is used to monitor progress and evaluate the success of the intervention. VSM is often implemented using the 4-step plan-do-check-act (PDCA) model in the following order: value stream identification, action plan, problem analysis and value proposition, action plan, and sustainability.

Pareto analysis. This is a formal, straightforward, and transparent method of assigning weight to identified problems; Pareto analysis can be useful when some identified problems are potentially more resource-demanding or time-consuming than others. It allows for approximating the priority of each problem and the urgency of the solution.¹³

Spaghetti diagrams. Charting by means of a spaghetti plot tracks actual physical flow. It has great applicability in cancer-care facilities, because the majority of oncology centers suffer from unproductive flows of patients, supplies, and documents. The Lean implementation literature indicates that in the majority of used cases, the actual setup was sufficiently complex to necessitate the use of spaghetti diagrams for the Lean team to be able to produce a solution.¹⁴

Affinity diagrams. An identifying feature of Lean management is that it incorporates the experience and competence of the practitioners directly involved in the process. Thus, discussion techniques such as brainstorming are favored over formal reporting. And that is where affinity diagrams come in: they are useful for organizing the ideas and data that emerge from brainstorming, sorting them based on associations.

The 5 Whys. This tool was devised by Sakichi Toyoda, one of the founders of the Lean approach.¹⁵ The "5 whys" is a technique used to determine

cause-and-effect to eventually identify the root cause of a problem. Why is asked repeatedly, using the previous answer to formulate the next question. This enables the stakeholders to address causes rather than simply addressing the effect. The technique is often accompanied by the use of cause-and-effect diagrams to illustrate the findings and improve understanding.

The 5S principles. This is a methodology that originally referred to 5 Japanese terms relating to efficient and effective organization of a work space.¹⁶ In spite of its original application to a limited space, this approach is applicable to a broader range of workplace configurations, including equipment layouts and strategic location of related activities. Usually, cancer-care facilities are conceived by "bootstrapping" new services without application of the 5S principle, which understandably leads to setbacks in efficiency.¹⁷

It is worth mentioning that while the tools and activities described above are recommended to streamline the process, they are not necessarily required for a transition to Lean practices. Furthermore, most of these tools are recommended for a more in-depth inquiry and monitoring of progress, while larger scale transformations, such as on an institutional basis, require their application on a selective basis. Basically, all of the techniques produce the best results when specifically adapted to address a particular issue.

For instance, timely and efficient patient admittance is an emerging issue in cancer-care centers due to suboptimal management of facilities available, and manpower. The first step in improving the situation would be to pinpoint the so-called "bottleneck," which is defined as a department or procedure associated with excessive workload or that presents a significant barrier to smooth patient flows. The arrival and registration area is commonly associated with patient-flow bottlenecks. Usually, the registration area employs several attendants who engage in administrative patient-intake procedures, organizing medical and nurse visits, scheduling and arranging chemotherapies, prescription refills, and treatment approvals, and seeing to a variety of other activities depending on the particularities of the establishment. In many instances both the patients and the staff of the facility report inappropriate waiting times, erratic document completion, delays, lack of coordination, data loss, and uneven distribution of tasks. The situation is aggravated by the fact that the majority of cancer-care facilities deal with patients who travel great distances and often arrive earlier than required and still face lines.

Outcomes of Lean implementation in healthcare. As Lean is already a recognized and thoroughly studied practice in American and European corporate culture,

it would be wise to assess the possible benefits of its implementation to get an overall idea of possible outcomes in Oman.

Case Study #1. It can be argued that the majority of issues can be defined as waste and, thus, they are susceptible to improvement by applying Lean practices, as was carried out in the Medical Oncology Unit of Hospital Regional do Vale do Paraiba (HRVP), near Sao Paulo, Brazil.¹⁸ The Lean team was identified and assembled, and a series of Lean training sessions and workshops were conducted. In addition, weekly meetings were scheduled to identify and evaluate quality improvements. Notably, no thorough evaluation or prior research was carried out to confirm the suggested reason behind the delays and inefficiency; instead, an estimate of Takt time, the average time between the beginning of one department's defined duties and the start of the defined duties of the next department, was determined. A simple calculation and a spaghetti diagram enabled the team to visualize the workload imbalance and determine the high-stress points in the process. The exercise also revealed that most patient routes within the facility were extremely confusing, and the Takt time analysis revealed the average 112-minute patient admission process consisted of only 37 minutes of value-added time, while the remaining 75 minutes were non-value-added time.¹³ After this, the team developed a series of suggested improvements and, importantly, a set of quantitative and qualitative measures to evaluate the Lean results.

Hospital Regional do Vale do Paraiba improvements included logistical restructuring, preparation of certain documents based known upcoming activities, redistribution of several tasks to and from the area in question, and, most importantly, establishment of a signaling system to alleviate a bottleneck of patients who were unnecessarily waiting for a go ahead after certain procedures in order to move to their next engagement or discharge. At this facility, the patients who had already fulfilled requirements for the day's regimen could avoid waiting needlessly and be "pulled" to chemotherapy directly.¹⁸ Finally, the new scheme of operations was evaluated using the same method. The observed results were recorded and compared to the projected outcomes; a significant improvement over the initial situation could be seen. Importantly, according to the team, no additional resources were needed throughout the Lean transformation-except for the time used to make necessary calculations, conceive a plan of improvements, and rearrangement of the furniture on certain occasions.¹⁸ While this example is not immediately applicable to Oman's cancer-care

facilities until necessary inquiries are made in each particular case, it provides several useful insights. First, it illustrates the impressive cost-efficiency of the suggested approach, in reality, no monetary outlay was associated with the entire experience. Second, while most of the steps taken were fairly standard and were not customized to the specific challenge, the chosen strategy still resulted in significant improvement. Third, the implementation, in this case, did not rely on costly and lengthy assessment, a fairly informal evaluation proved sufficient.

A similar framework can be applied to various cancer-care functional areas in Oman. For instance, in our country, the patient intake process, new patient slot availability, systematic and coordinated scheduling, transfer and handling of medical records, and scheduling of lab functions or infusions share the same process structure and a comparatively similar range of problems. Thus, the exemplified framework can be used in Omani cancer-care centers with only minor alterations. On the other hand, reducing the required number of steps per engagement, reorganization of physician orders, changes in work schedules of certain departments and rooms, and staffing/shift adjustments are only partially consistent with the suggested model and, therefore, will require a somewhat different approach and the introduction of additional benchmarking techniques such as questionnaires, insert them to provide input about known bottlenecks, surveys, and computerized logging methods integrated into patient-centered software.¹⁹

Case Study #2. A more comprehensive Lean transformation was undertaken by Aptium Cancer Care, a subsidiary of US based Aptium Oncology.²⁰ Instead of targeting a specific issue and devising an action map with concrete steps, the Aptium team conceived 3 encompassing categories. First, instead of relying on the traditional concept of an employee, they introduced a culture that prioritized certain traits and mind-sets over others, allowing the Human Resources Department to identify open-minded workers who were not reticent to change. That this trait has found among the identified worked was confirmed through interviews at the initial stage, and this open-to-change predisposition was nurtured through training sessions immediately after the workers were identified and later in the course of the transformation. Job descriptions and performance reviews were also redesigned with Lean principles in mind, and workers were encouraged to apply Lean principles in everyday activities. Importantly, the organization's transformation plan also acknowledged and addressed individuals who

were reluctant to undergo culture change by providing incentives and encouraging them to provide input about known bottlenecks. Second, an end-to-end process was developed to ensure all stakeholders' familiarity with as many aspects of healthcare as possible, including financial and administrative functions. The process involved developing a specific plan in which each process was deconstructed to clarify the objectives of patients and staff members, the "quick wins," and the long-term benefits of achieving the outlined goal. The end-to-end-process revealed main elements that would contribute to improved operations, as well as possible ensuing issues, and it suggested ways of overcoming them. Finally, alternative routes were mapped to account for possible deviations.

The resultant plan was then used to determine causes for weaknesses in the process and to find ways of avoiding them in the future. Importantly, accountability for the endeavor was shared, based on the principles of a no-blame culture, which further diminished reluctance to participate and/or take responsibility. Third, the process was reviewed on an ongoing basis, and it was systematically compared to the planned outcomes. A similar type of monitoring was also incorporated in the ongoing training sessions and was used to enhance staff members' motivation.

As can be gleaned from the example above, the implementation of a Lean philosophy does not need to be focused on a specific issue; rather, it can be applied broadly, such as to the operations of an entire complex. In addition, while some unmentioned issues were undoubtedly triggers for implementing Lean healthcare, the method described can provide overall improvement in organizations functioning at all levels of efficiency. Again, at certain points, developing a scheme such as the one highlighted in the Aptium example may be necessary, but in the long term, the Lean culture will decrease the need for such interventions, as the staff will generally become amenable to the ongoing improvement and readjustment.

Additional outcomes. One of the most recognized benefits, in light of the steadily rising cost of cancer care, is the economic effect observed after a shift to Lean. American hospitals, for example, report the decrease in expenses associated with Lean. One hospital in South Dakota that adopted a Lean philosophy facility-wide reported that adjustments to its medical records system, resulting in faster charting, enhanced patient care. That, combined with Lean improvements to the hospital's accounts receivable processes resulted in a one-time savings of US\$2.5 million.²¹

One reason for such a gain in cost efficiency is the elimination of preventable billing errors which, when recognized by payers, set off a time-consuming fact-finding process and impact the cash flow of hospitals. Graban²¹ also cites improved services as a reason behind higher revenues: the length of hospital stays was reduced by 29%, the time required for equipment set-up was decreased by 70%, and the waiting times were substantially cut. The equipment set-up improvement enabled the facility to accommodate more patients, while the shortened waiting times improved customer satisfaction. A reported 95% decrease in septicemia-associated deaths also contributed to higher excellence of patient care, improved consistency of care, warranted patient safety, and strengthened self-esteem and morale of employees and customers.

A 17% increase in patient flow coupled with a 4% cost reduction was also reported by the McKesson Oncology Network USA.²² Importantly, the center also observed a 6% increase in new patient volume that the organization attributes to reduced waiting times, increased patient satisfaction, and increased referrals. The staff also reported higher satisfaction with their improved workplace conditions, which brought about improved workload balance, optimized staff capacity, and a reduction in the need to perform various functions a second or third time.²²

An implementation of Lean in uro-oncology showed similar results. Sixty days after the Lean initiative was launched, the median cycle time (patient arrival to discharge) went from 46 minutes to 35 minutes, and the average length of a physician assessment increased to 10.6 minutes; it had been 7.5 minutes when the initiative was launched.²³ Overall, both the duration of initial assessments and the patient, cycle time improved, with an average proportion of value-added time increase from 30.6% to 66.3% after 90 days.²³ Such efficiency accounts for the widespread application and acceptance of the Lean philosophy in NHS hospitals in the United Kingdom.²⁴ The staff at HRVP enjoyed similarly impressive results. The average waiting time from registration to surgery dropped by 61% (from 90 days to 35 days), while the average time from registration to the first chemotherapy visit saw a 50% improvement (from 114 days to 56 days).²⁵ The Lean system also resulted in the decrease of a number of pre-surgery hospital visits from 7 to 2, with the second visit being on the day of surgery for some patients. While budgetary benefits were not reported in the article, we can assume that the improved efficiency garnered fiscal gains.

On the whole, the intermediate outcomes of Lean implementation are mostly observable among

the employees (improved ability to recognize waste, readiness to change, satisfaction, and Lean routinization), while ultimate outcomes (increased efficiency, shorter wait times, customer satisfaction, economic sustainability resulting from reduced expenses, and overall improvement in quality of care) benefit all stakeholders.²⁶

Implementing a Lean philosophy in cancer-care services in Oman. As mentioned earlier, the reported difficulties with the Lean approach in healthcare coincided across studies and commonly included extremely long patient admittance, long waiting times, transportation, and the absence of coordination among various clinicians and departments, as well as in the scheduling of required screenings and diagnostic procedures.²⁷ While no hard data exists to confirm the coincidence of issues or suggest the inevitability of those issues occurring in Omani cancer-care facilities, it is prudent to assume that at least some issues are intrinsic to oncology practice worldwide. For example, the organizational structure of oncology care demands the presence of multiple entities and equipment, requiring specific coordination efforts to avoid confusion. The commonality of reported bottlenecks and pressure points within healthcare facilities¹⁰ suggests that similar interventions and improvements may be effective. The figure shows a possible schematic representation of how to implement Lean approach in cancer care services.

Key performance indicators for cancer care in Oman.

As described above, the application of a Lean philosophy requires regular benchmarking and monitoring of specific key performance indicators (KPIs)-measurable elements that evaluate the organization's success at reaching targets-regardless of the scope and time frame. For cancer care in Oman, the following KPIs can be suggested:

- 1) The waiting time for new, non-urgent patients, as measured from the time of request.
- 2) The waiting time for a review, measured from arrival.
- 3) Compliance with the pre-specified durations of all appointments and consultations in the oncology department as well as related departments.
- 4) Proportion of newly diagnosed cancer cases discussed by a dedicated multidisciplinary team.
- 5) Completion of scheduled tests and required diagnostics within the pre-defined time frame.
- 6) Ongoing monitoring and assessing of unplanned admissions as well as re-admissions after planned discharges to determine whether processes can be implemented to avoid such future occurrences.

7) Ratio of comprehensive and informative case descriptions in surgical pathology reports to prevent the need for unnecessary inquiries.

8) Appropriate and justified administration of advanced diagnostic procedures such as PET and CT scans.

9) Provision of information about and availability of the breast conservation procedure.

10) Performing non-operative histological core needle biopsies when possible.

11) Coordination and systematization of radiologic investigations.

12) Ensuring the availability and accessibility of neoadjuvant and post-operative therapy for patients with high-risk breast cancer.

13) Providing appropriate radiotherapy for breast cancer patients who underwent local excision.

14) Appropriate evaluation for locally advanced, nodal or bony metastatic disease for high-risk prostate cancer patients.

It should be specified that points 1 through 8 represent the direct outcomes of Lean healthcare and are universally applicable to cancer care and, with minor adjustments, to other fields within healthcare, while points 9 through 14 are indirect by products of the suggested transformation and will likely be observed in the long run rather than in the initial stage. Thus, the first 8 list entries can be described as organizational KPIs, while the remainder represent operational improvements and should be viewed as ultimate positive outcomes rather than direct monitoring tools.

In conclusion, Lean implementation is a necessary transformation in light of the factors mentioned above that involve employees, quality assurance, and structured management. The growing cost of cancer treatment, coupled with recent events demonstrating the instability of the global economic environment, require cost-efficiency improvements in cancer care. The widening gap between customer financial capacity and demand for oncology services further aggravates the problem and necessitates swift and effective intervention. The current rate of cancer incidence in Oman and the projected rise of patients with cancer suggest the need for improved performance of existing care centers. The reviewed results show tremendous improvements in efficiency and financial performance of organizations without significant additional resource allocation. However, it should be acknowledged that Lean implementation is only possible when the staff is sufficiently dedicated and persistent and, at the same time, displays good understanding of goals, benefits, and barriers along the path in achieving a Lean culture. Thus, while it is tempting to perceive Lean as a quick

and easy solution for the majority of organizational, operational, and financial issues, it would be more accurate to consider it a long-term investment that is not restrictive financially or academically.

To conclude, the current state of Omani oncology-care delivery requires change, and the Lean philosophy is a perfect candidate for adoption, considering its accessibility, sustainability, universality, and diversity of applications. Simply put, we are both prepared and capable of implementing it in cancer care in Oman.

Acknowledgment. *We acknowledge with gratitude the efforts of all working staff endeavoring to provide comprehensive cancer-care services with equity despite limited resources. We acknowledge the effort of Itrat Mehdi for drawing up the diagram in the article for articulating and simplifying the concept. We are grateful to all our patients for their patience, endurance, and trust in their treatment teams.*

References

1. Prengel AW. Everything should be made as simple as possible, but not simpler. *Crit Care Med* 2013; 41: 2816-2817.
2. Duska LR, Mueller J, Lothamer H, Pelkofski EB, Novicoff WM. Lean methodology improves efficiency in outpatient academic Gynecologic Oncology clinics. *Gynecologic Oncology* 2015; 138: 707-711.
3. Holden RJ. Lean thinking in emergency departments: a critical review. *Ann Emerg Med* 2011; 57: 265-278.
4. Campbell RJ. Thinking Lean in healthcare. *JAHIMA* 2009; 80: 40-43.
5. Mozzocato P, Savage C, Brommels M, Aronsson H, Thor J. Lean thinking in healthcare: a realist review of the literature. *Quality and Safety in Health Care* 2010; 19: 376-382.
6. Montesarchio V, Grimaldi AM, Fox BA, Rea A, Marincola FM, Ascierio PA. Lean oncology: a new model for oncologists. *J Transl Med* 2012; 10: 74.
7. Young TP, McClean SI. A critical look at Lean Thinking in healthcare. *Quality and Safety in Health Care* 2008; 17: 382-386.
8. Toussaint JS, Berry LL. The promise of Lean in health care. *Mayo Clin Proc* 2013; 88: 74-82.
9. Belter D, Halsey J, Severtson H, Fix A, Michelfelder L, Michalak K, et al. Evaluation of outpatient oncology services using Lean methodology. *Oncol Nurs Forum* 2012; 39: 136-140.
10. Al-Moundhri M. The need for holistic cancer care framework: breast cancer care as an example. *Oman Med J* 2013; 28: 300-301.
11. Khan M. MoH report says 25% rise in cancer cases in Oman. [cited 2014]. Available from URL: <http://www.muscatdaily.com/Archive/Oman/MoH-report-says-25-rise-in-cancer-cases-in-Oman-2wvy>.
12. Bhattacharjee M. Cancer rate in region could double by 2030 [cited 2016]. Available from URL: <http://www.muscatdaily.com/Archive/Oman/Cancer-rate-in-region-could-double-by-2030-WHO-4l84>.
13. Chart P, Di Bucchianico A. Wiley StatsRef: Statistics Reference Online. New Jersey (NJ): John Wiley & Sons, Inc.; 2014.
14. Dinis-Carvalho, Moreira F, Braganca S, Sousa RM, Alves AC, Costa E. Waste identification diagrams. *Production Planning and Control* 2014; 26: 235-247.
15. Serrat O. The Five Whys Technique. Knowledge Solutions. [cited 2009]. Available from URL: www.adb.org/sites/default/files/publication/27641/five-whys-technique.pdf
16. Gupta S, Jain SK. An application of 5S concept to organize the workplace at a scientific instruments manufacturing company. Research Gate. March 2015 DOI: 10.1108/IJLSS-08-2013-0047. <https://www.researchgate.net/publication/276377576>
17. Deschenes S. 7 ways Lean healthcare management reduces cost [cited 2012]. Available from URL: <http://www.healthcarefinancenews.com/news/7-ways-Lean-healthcare-management-reduces-cost>.
18. Pinto CF. Improving wait times at a medical oncology unit. [cited 2016]. Available from URL: <http://www.Lean.org.br/comunidade/saude/ebcp/pdfs/intro.pdf>
19. Murphree P, Vath RR, Daigle L. Sustaining Lean six sigma projects in health care. *Physician Exec* 2011; 37: 44-48.
20. Murphree P, Vath RR, Daigle L. Sustaining Lean Six Sigma in healthcare. *Physician Exec* 2011; 37: 44-48.
21. Graban M. Lean hospitals: Improving quality, patient safety, and employee satisfaction. Boca Raton (FL): CRC Press; 2011. p. 14.
22. Fryefield DC, Kafora R, Bradshaw-Hucko L, Tribble C, Jensen T, Chentnik T, et al. Community oncology care delivery staffing model. *ASCO Annual Meeting Proceedings* 2012; 30: 87-95.
23. Skeldon SC, Simmons A, Hersey K, Finelli A, Jewett MA, Zlotta AR. Lean methodology improves efficiency in outpatient academic uro-oncology clinics. *Urology* 2014; 83: 992-997.
24. Yousri TA, Khan Z, Chakrabarti D, Fernandes R, Wahab K. Lean thinking: can it improve the outcome of fracture neck of femur patients in a district general hospital? *Injury* 2011; 42: 1234-1237.
25. Marotta E, Rais SV, Coelho SM. A fast track to cancer treatment. [cited 2015]. Available from URL: <http://planet-Lean.com/when-Lean-management-matters-most-improving-cancer-care>.
26. Carman KL, Paez K, Stephens J, Smeeding J, Garfinkel S, Blough C. Improving care delivery through Lean: implementation case studies. Available from URL: <http://www.ahrq.gov/sites/default/files/publications/files/Leancasestudies.pdf>.
27. Joosten T, Bongers I, Janssen R. Application of Lean thinking to health care: issues and observations. *International Journal for Quality in Health Care* 2009; 21: 341-347.