
Review Article

Understanding the Cost & Outcomes of Pediatric Leukemia in the United States: A Review of Current Literature

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ABSTRACT

The cost associated with healthcare has continually increased over the years mainly for oncologic care and treatment of chronic conditions. These trends have also coincided with increasing closure of community or local governmentally assisted healthcare organizations. These means local care provision for patients with cancer is likely to increase for parents, insurance (Governmental and Private) as well as healthcare organizations. Some studies have evaluated specific leukemia subtypes within healthcare systems. The financial burden associated with diagnosis increased hospitalizations because of stress both physical and psychological on patients and parents. Cost of care varies for patients based on disease severity and mortality risks. The total cost of care and drug costs increased significantly across the country. This paper provides a clearer picture of the diverse factors that impact patient outcome improvement and cost increase. It is imperative to address the coverage gap as well as social support for parents to adequately address the diversity of factors that impact outcomes and cost.

Keywords: Leukemia, Lymphoid, Health Outcomes, Cost, Charges, Cost Influencers,

INTRODUCTION

As the availability of resources for health care expenditure decreases, the prevalence of specific chronic conditions has increased because of improved care approaches and targeted therapies. A thorough study of malignancy pediatric or others wise has proven very successful in the aspects of treatment and improving health outcomes. The question of financing these treatments is imperative in ensuring affordability for the patient and their families as well as financial stability for organizations that provide these services. Leukemia of lymphoid origin and particular acute lymphoblastic leukemia (ALL) is the most common pediatric malignancy; an in-depth understanding of the various determinants of cost and charges within the

healthcare setting is imperative in developing effective financial planning and strategic resource allocation.

These chronic malignancies tend to be very costly and financial take up a considerable sum of organizational resources. Several kinds of literature have evaluated the effect of cost on some subgroups of leukemia in local settings. There is a need for a national analysis of this malignancy with a focus on the relationship of cost on demographics, income, survival, and mortality. An understanding through such a study would enable health administrators actively inculcate data finding into organizational business planning to ensure financial solvency. Furthermore, healthcare providers could utilize this information in finding ways of

improving outcome and cost by adopting alternative treatment for a patient in outpatient settings instead of individual inpatient care.

MATERIALS & METHODS

Search strategy began with the Rutgers university library which provided access to library databases.

Database Search Terms

PubMed *ALL, Lymphoid Leukemia, Cost, Charge*

EMBASE *Leukemia, ALL, Healthcare Cost, Charges*

Google Scholar *Cost of pediatric cancer treatment, Leukemia*

PAIS Index *Healthcare Cost, Management, Pediatric, Cancer*

PLOS One *Pediatric, Cancer, Cost, Leukemia*

The literature review process was carried out for publications in the last 20 years. The reason for this is to mainly see the difference in research and treatment approaches in treating pediatric cancer in general and advances made in chemotherapy and targeted therapy. Another important reason for such approach was to evaluate the survival and severity or complications, and mortality other publications have found about cost. The focus on pediatric healthcare cost publication for the last 10years (2007-2017). The rationale for this is the drastic changes in approaches to treatment during this time and the impact of new targeted therapy on increasing survival and also evaluate reported increased incidence. The researched focused on peer-reviewed, metanalysis, systematic quantitative literature review. Publications that met the criteria mentioned above were selected and evaluated for association with healthcare cost, healthcare financial management, pediatric cancer, leukemia, acute lymphoblastic leukemia, Subacute lymphoid leukemia.

RESULTS

Inpatient Cost of Care

In the past years, there has been a continuous increase in the cost associated with medical care in the United States. These increase in healthcare cost has affected all aspects of care especially cancer treatments. ^[1] Pediatric malignancies or cancers are not as common as those of adults, but the incidence and diagnosis of pediatric cancer have been increased for the past 30 years, and the inverse is true for mortality. The mortality rate for pediatric cancer has decreased tremendously in recent years as a result of improvement in treatment strategies and effectiveness of chemotherapy and targeted therapies. ^[2,3] The most common type of pediatric cancer or malignancy is Leukemia with Acute Lymphocytic Leukemia (ALL) being the most common subset.

ALL is estimated to affect about 25% of all pediatric cancer population. Furthermore, there has been an increase in the number of ALL diagnosis over the years. ^[4,5] Pediatric cancer hospital stays (LOS) are on average longer than any medical illness in the pediatric population. The average cost of per stay for leukemia patients in the United States from 2000-2009 was about \$55000. The mean cost per stay for these populations has also risen by about 35 percent for the same duration per HCUP data. This cost is likely to continue to increase in the publication of the next dataset. ^[5] A thorough understanding of all aspects and areas, directly and indirectly, affecting the cost of care is imperative to finding ways of improving care provision and also cutting cost associated with leukemia care. ^[5] Healthcare cost varies in various countries in the developed world; it is also true that the outcome and cost of care vary much when one looks across the United States as a whole. The payment modalities, as well as survival severity, has in some instances be associated with income and demographics. It is then imperative once again to understand the protocols and strategies utilized in other parts of the country if such strategies cost less and have

the same or comparative outcome of survival and disease severity.

In a study conducted by Kaul et al., they discovered that higher cost associated with ALL care was significant at high risk ALL patients; furthermore, high cost did not indicate low effectiveness in treatment approaches.^[7,8] Many studies have indicated that there is a continuous need for inpatient care from 1-5 years of diagnosis. Also, as the rate or frequency of hospitalization increased with a report of increasing financial burden for both patient's families and the source of payments.^[9,10] The findings of such a study provide a detail description of the complexities that come with treatment as well as time from diagnosis to 5-year treatment period. It could also mean that high-risk individuals have these associated costs because of relapse as well as intensive therapies. Moreover, it imperative to look at the reasons for the spike in cost over the past decade. The question of what and how treatment approaches are utilized need to be evaluated to answer these questions specifically. Why the cost of care was highest in the first six months of treatment^[11] also needs to be looked at from the standards or regimen of care, time of diagnosis and age of patients.

Even though there is a concerted effort on the part of many healthcare organizations to cut cost associated with cancer care and Leukemia in this case that has not proven successful until now. There is some indication that outpatient, homecare treatment of non-high-risk care can aid in cost reduction.^[12] The hospitalization of high-risk events is on many occasions associated with toxicities that increase or prolong hospitalization risk and hence increased overall cost. There is a considerable amount of information of the reasons for frequent hospitalization in patients with ALL. These include neutropenia, fever, infections, and chemotherapy or chemo-radiotherapy related side effects. The acute presentation should be addressed in a hospital setting as

indicated by several studies on the complexities of an issue that may arise.^[13-15]

A detailed understanding of all these factors about outpatient admission is essential in creating systems that would aid addressing the problem increased cost and its inhibition of effective long-term budgeting for healthcare organizations. For instance, the creation of a decision supports systems that would aid in prompting physicians about fever; neutropenia risk would aid in improving alert systems as well as care approaches. Furthermore, the inclusion of technology that alerts caregivers, patients, and parents of these changes would aid in further alert and most likely seek outpatient care. A similar system could also be utilized in forecasting the potential cost for each of these malignancies in the future. Such models as those created by Bradley et al. could be a valuable tool for health policy, governmental and healthcare management professional in an organization.

Cost of Emergency Care, Geography and Cost

The unpredictability of cost or changes in the process of caring for patients with ALL as with other malignancies necessitates the utilization of emergency care. Emergency care has been historically the top and most expensive care provided to individuals with all kinds of medical presentations. On some occasions, the lack of full records of these patients' health records risks medical approaches that could be detrimental to their health. For instance, the likelihood of certain drug contraindication and changes in treatment approaches could occur during such emergency hospitalizations. These could then lead to worsening of general patient's health, infections, more prolonged hospitalization as well as an increased in cost of care.

The increased cost also comes with extensive inpatient care as well as procedures and therapies. As we gain more understanding of the dynamics and

characteristics associated with oncologic care, it is a common understanding that these cares are often associated with acute and symptom management. ^[16,17] It is a widely accepted idea that improvement of outpatient or home care services is unlikely to decrease emergency services as well as inpatient services. Some studies have shown a tiny percentage of individual presentations could avoid utilization of ER services. However, the question of how to approach the less severe presentations needs to be addressed as well. The reason for this is to ensure that the cost of care is minimized in these populations.

Another essential aspect associated with emergency care is the issue surrounding geographical location of individuals diagnosed with cancers. ^[18] On occasions, individuals and their families have to move closer to areas with specialized care services after diagnosis. In locations where, emergency services are not adequately equipped, providers usually have difficulties providing care to the required standards. At times, patients are likely to wait long periods of travel to facilities that specialize in these services. This could increase the likelihood of complications as well as the cost of emergency care. ^[11,19]

Patients diagnosed with ALL and other leukemia of lymphoid origin or other types of pediatric cancers living in the rural or remote area on occasions have to utilize costly means of receiving emergency care such as air transport. ^[20] Some cost associated with care especially in the emergency setting comes out of pocket, and the travel expenses put a massive dent in family finances. ^[20] Some research has estimated the out of pocket cost for individuals ranged between \$7500- \$25000. ^[21] Furthermore, these expenses are likely to be higher for parents because of an increased probability of visits to healthcare centers or clinics as well as general transportation costs. Families of children with pediatric cancers such as ALL have to move to areas closer to cancer care centers;

this adds a substantial financial constraint to their financial stability.

Health Insurance Coverage and Gap

Health insurance coverage is an essential part of the total healthcare cost in the United States. The primary health insurance utilized in the U.S health systems includes Medicare, Medicaid, State Children Health Insurance Programs (SCHIP) and work or employer-sponsored programs. It is estimated that the average cost of employer-sponsored coverage is about \$18,142 in 2016. Employees are estimated to be paying about \$5,277. ^[22] This cost is more than 3 percent increase compared to a year ago, and it is even more complicated for individuals with children diagnosed with a malignancy. The number of emergency services received by these populations as mentioned above is about 80% more. ^[22,23] This then utilizes all funds available for patients and creates intense problems for patients concerning premiums and coverages. Some reports indicate patient and parents often ignore specific presentations such as fever and other signs of potential problems to avoid utilizing all premiums. Coverage has continued to affect more individuals even with the affordable care Act that prohibited disqualification by insurance companies because of preexisting medical conditions. ^[24] These various problems associated with care affects parents in different ways, and this affects their insurance coverage.

Governmental aided insurance coverage such as Children Health Insurance Program (CHIP), Medicaid and employer-based coverage are a significant part of the insurance coverages in the healthcare systems primarily for the pediatric population with malignancies. An estimated two-thirds of all uninsured children are eligible for Medicaid or CHIP programs in the U. S. The process of enrollment and eligibility significantly varies in each state. The complicated processes of application, as well as renewal frequency, are some of the reason for lack of enrollment and insurance

coverage for many qualified children. [25] This then results in a likelihood of increased premiums for coverage and total cost of care because of late diagnosis and most importantly medical complications. Moreover, as premiums increase, the relative enrollment to some of these programs decreases. This directly affects patients with malignancies or chronic conditions because of the inverse relationship with access to care. Health insurance coverage impacts these populations even after they survive these childhood cancers. It is hence crucial for thorough evaluation of all the characteristics associated with the role of coverage and access to care and services.

The coverage of programs such as CHIP has about 8.5 million children across the United States, and the recent expiration in September 2017 put at risk these populations. Many of the enrollees in this program do not qualify for Medicaid; [26,24] this means the direct financial cost for parents and hence the likelihood of inability for compensation for medical services rendered. It is likely that when the federal funds provided to states run out sometime March 2017, this will exacerbate the cost of care as well as finances of families and healthcare organizations in diverse ways. A study such as this that specifically looks at one of the significant utilizers of healthcare resources will aid in better policy making and resource allocation for national and regional levels.

Even though the coverages as mentioned above are essential in ensuring continuity of treatment for patients with the cancer diagnosis, there is considerable evidence to suggest the existence of gaps in the coverage for these populations. [25,27] Furthermore, the changes in political climate and variance in governmental policies directly affect access to care especially for patients undergoing cancer care. The funding for CHIP program has been virtually exhausted by a significant number of the 50 states so far; the question of coverage and uncertainty does not lie

with parents to pay out of pocket if Medicaid is not funding for care. This uncertainty does affect not only families but also healthcare administrative processes. Such scenarios are the reason why it is imperative for organizations and policy to make to gain a detailed understanding of the cost of care for these populations. These gaps are directly or indirectly related to the various dynamics associated with the processes of seeking care for leukemia and other pediatric malignancies.

In many instances, parents move closer to areas of services, lose full time working status for employer coverage or merely lose their jobs. Some research indicates individuals utilizing these insurances were likely to have gaps in care compared to privately insured. This means the likelihood of complications due to lack of treatment or even primary care in the population of individuals with ALL is increased. Complications in these populations means hospitalizations with more advanced disease presentations. [28] These are usually associated with high care cost due to complications, emergency services, and inpatient care. It also means an increase in the total cost that would be associated with an individual's care because of the increased emergency visit and the likelihood of severe presentation. Furthermore, the probability of increased mortality in these patient populations is higher because of complications that may arise with treatment or secondary infections. [29]

There is a strong association between coverage and access to healthcare in both adult and pediatric population. This association has also been established in the care for patients with malignancies including leukemia. The dynamics associated with health insurance coverage in the United States is directly related to care approaches. An understanding of how these coverage policies impact patient accesses to care would aid in obtaining better insights to care approaches. Furthermore, it would aid stakeholders better understand areas where

collaboration is feasible to decrease the gap between coverage and potentially decrease the cost of care for these conditions.

Treatment and Pharmaceutical medication Cost

Patients are often prescribed medication to aid in alleviating or even eliminating their medical conditions. These medications are an essential part of the treatment plan; these medications are not only essential in cancer treatment they are a must. They are not only self-administered, but some are also utilized intravenously during inpatient care. In the past decade, more targeted medications have been developed, and these have been proven to be very useful in the treatment of cancer for adults and pediatrics alike. [30,31] There are continuous introduction and approval of new cancer treatment drugs and biologics by the FDA. Furthermore, the development of precision medicine, as well as advancements in immune therapy, serves as hope for individuals diagnosed with these malignancies. The effectiveness of these therapies comes at a significant cost. [32] By some estimates, the cost of pharmaceuticals administered during inpatient cancer treatment and oral medications are underestimated.

A significant part of this cost of care is that of medication prices and the continuous rise of deductibles and cost shifting. The rising cost may result in several issues that can affect the overall health of patients. Patients may delay or decrease taking the right dosage for financial reasons or constraints. [33] There are many instances where the patient develops complications or worsening of current medical condition because they cannot afford copayments for their prescriptions. A significant number of individuals are reporting issues with payments and how they directly affect adherence to the regimen. Many of these individuals that cannot afford the medication or treatments tend to refrain from seeking medical care. This then leads to an increase in the likelihood of

complications and a further increase in the cost of emergency and inpatient care.

Leukemia and non-Hodgkin's lymphoma are the first and second most expensive to treat pediatric malignancies in the United States. There are several costs associated with pediatric care that is rarely reported and hence not examined. These costs tremendously directly and indirectly increase the burden associated with caring for individuals ALL and other pediatric malignancies.

DISCUSSIONS

These costs include travel, food, labor, medical help or aid, equipment's or supplies among many others. In many instances, these financial costs are not covered by insurance coverage and come directly from parents or end up being unpaid. These then take a tremendous toll on families' finances and often lead to constraints. The cost as mentioned above is incurred in the processes of ensuring individuals receive the necessary care as well as make them comfortable. For instance, families have to adjust dietary intake as well as make a supplemental budget for food that is not contraindicated in the treatment being received by children. [11] On occasions, parents have to provide copayment for medication; in many cases, these are costly treatment not covered entirely by insurance. Parents end up using up their saving and become deeply indebted during the process of caring for a child with cancer because increased cost sharing in coverages.

Many individuals must travel extensively during the process of care provided to different cities sometimes states. Parents sometimes must stay overnight or days if they do not live close to care centers. They must pay for accommodation at these locations and hence an increase in total financial cost. This takes a significant toll on finances and results in moving close to cancer care centers. Difficulties in obtaining new jobs or even work with schedules that will enable them to care for their wards at

the same time is a huge problem. Employment also means an avenue to obtain health insurance, and hence the likelihood of paying out of pocket because of moving to a new location adds to families' costs and expenditures.

Another problem parents encounter is the issue of labor, they have to pay for services if they hire caretakers while they are at work. [11] Other implications associated with care for childhood cancer is the adverse parental health and emotional ramifications. [50] It is hence imperative to gain a better understanding of how the stress associated with care forwards will increase the cost of care for parents as well. These could then lead to missed work days or even disruption in the care of the child. Moreover, the complication could arise in treatment approach increases cost of care and further complicate family's financial situation. It is imperative for all stakeholders in the healthcare industry to understand the various impact of all aspects of care in making decisions the tremendously affects all aspects of a family lives.

CONCLUSION

It is clear and widely agreed on that cost of care in the field of cancer treatment is rising because of many factors as such as increased treatment effectiveness, increased survival rates, and frequency of healthcare visits by these populations. It is also a widely accepted view that the trend of continuous cost increase is not proportional to the quality of care or survival. The estimation that the number of individuals that needs extensive coverage the medical conditions including malignancies primarily for the pediatric conditions is increasing. The current uncertainty around coverage for those that do not qualify for Medicaid calls for a thorough analysis of all aspects of care provision and development of a strategic financial strategy to ensure these individuals could be cared for. This leads to the question what could be done to address

issues pertinent to direct health care cost and how it could be curbed.

An analysis of the impact cost of survival and also the relationships between income level, access, and quality of care have been non-existent on a national scale. The continuous increase in the cost of care for leukemia is likely to have the dramatic effect of the allocation of resources both for health organizations and policymakers. Outpatient care for cancer treatment has been a topic increasing importance considering the rising cost of care. Several studies have shown better outcome for outpatient care for several complications associated with leukemia care. [10] Many others have found that there less likelihood of readmission with outpatient treatment compared to inpatient care - there little explicitly known about the relationship between cost, demographics income, severity, and mortality. Most studies in this field have not focused on differences in outcomes and cost in different regions but mainly localized to a specific States or Healthcare systems. The findings of such a study could aid in shedding some light in the diversity of cost and outcome influencers in these patient population.

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