

# Distance as a Barrier to Cancer Diagnosis and Treatment: Review of the Literature

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**Key Words.** Travel burden • Distance from hospitals • Cancer patients • Cancer diagnosis and treatment • Outcome • Quality of life

## ABSTRACT

The burden of travel from a patient's residence to health care providers is an important issue that can influence access to diagnosis and treatment of cancer. Although several studies have shown that the travel burden can result in delays in diagnosis and treatment of many common cancers, its role appears underestimated in the treatment of patients in clinical practice. Therefore, we performed a review of the published data on the role of travel burden influencing four items: delay of diagnosis, adequate treatment of cancer, and outcome and quality of life of cancer patients. Forty-seven studies published up to December 2014 were initially identified. Twenty studies were excluded because they did not regard specifically the four items of our review. Twenty-seven studies formed the basis of our study and

involved 716,153 patients. The association between travel burden and (a) cancer stage at diagnosis (12 studies), (b) appropriate treatment (8 studies), (c) outcome (4 studies), and (d) quality of life (1 study) are reported. In addition, in two studies, the relation between travel burden and compliance with treatment was examined. The results of our review show that increasing travel requirements are associated with more advanced disease at diagnosis, inappropriate treatment, a worse prognosis, and a worse quality of life. These results suggest that clinical oncologists should remember the specific travel burden problem for cancer patients, who often need health care services every week or every month for many years. *The Oncologist* 2015; 20:1–8

**Implications for Practice:** The influence of travel burden on cancer patients has been previously studied, but this is the first comprehensive review of the available literature. This review shows that travel burden negatively influences stage at diagnosis, appropriate treatment, outcome, and quality of life in cancer patients. The results demonstrate that clinical oncologists should keep in mind the specific travel burden problem for cancer patients who often need health care services every week or every month for many years.

## INTRODUCTION

It is well known that patients with cancer must overcome many psychological, social, economic, and family barriers to obtain the diagnosis and treatment needed. In addition, the burden of travel from a patient's residence to his or her health care provider can be an important issue that can influence access to diagnosis and treatment services for cancer needs [1]. The necessity for repeated visits for cancer diagnosis and treatment on an outpatient or an inpatient basis makes distance an important issue with which the patient with cancer must manage during the disease course [2].

Oncologists agree that the selection of the treatment regimen for a cancer patient depends on numerous factors, including the type of malignancy, stage, histologic features, tumor genetics, and previous therapies [3]. Other factors are

patient-related, such as functional status, burden of comorbidities, and status of social support [4].

Several studies have documented that the travel burden (measured as the travel distance or travel time) can result in delays in diagnosis and can influence the choice of treatment of a variety of common cancers [5–9]. However, these factors might not necessarily be considered consistently in the daily management of cancer, such as in the selection of the treatment regimen and the selection of treatment dosing [3, 4].

The most relevant objectives of health policies are to improve the quality, safety, patient satisfaction, and health care efficiency, as reported in a recent review [10]. It must be emphasized, however, that consideration of the role played by the travel burden in cancer patient management might be insufficient [3, 4, 10]. It is therefore with special emphasis on

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patient-centered care that we provide a review of the available data on the association between travel burden and the cancer stage at diagnosis, appropriate treatment, outcome, and quality of life. In particular, the objective of our review was to examine whether the travel burden has a negative influence on cancer patients regarding these four aspects: (a) cancer stage at diagnosis, (b) appropriate treatment (treatment performed or omitted), (c) outcome, and (d) quality of life (QoL).

## METHODS

We provide a narrative review of the published data.

### Inclusion and Exclusion Criteria

Studies that evaluated the association between travel burden and the four aspects considered relevant in the treatment of cancer patients: (a) cancer stage at diagnosis, (b) appropriate treatment (treatment performed or omitted), (c) outcome, and (d) quality of life were included in the present review, which was centered on both curable and incurable cancer patients. Only studies exploring the role of travel burden itself were considered for the review. Consequently, studies that had reported other aspects, such as sociodemographic factors, race, ethnicity, or insurance, rather than travel burden (or in association), were excluded. Studies investigating other aspects of oncological treatments, such as palliative radiotherapy for bone pain or adherence to screening programs, even if related to travel burden, were also excluded if they were not related to one of the four items already summarized (cancer stage at diagnosis, appropriate treatment, treatment performed or omitted, outcome, and quality of life).

### Study Identification

A computerized literature search through PubMed, CANCELIT, Embase, and Cochrane Library was performed applying the words travel burden; distance from hospitals; time to therapy; time to medical services; time to hospitals; cancer patients; cancer diagnosis and treatment; outcome; survival; and quality of life. Reports and abstracts were also identified by back-referencing from the original and relevant studies. Only studies published in English before December 2014 were selected for the present review. Studies published only in abstract form were excluded. Four of us (M.A., C.B., F.F., and L.C.) evaluated the titles and abstracts and then the full text of the studies considered potentially eligible for the present review. If in doubt, a fifth author (C.D.G.) was consulted to reach an agreement.

### Data Extraction and Analysis

Three of us (M.A., C.B., and L.C.) independently extracted qualitative and numerical data from the included studies, resolved differences through consensus, and analyzed the data qualitatively.

## RESULTS

The total number of studies identified in our search was 47; 20 studies were excluded because they had not specifically considered the objects of our review [11, 12] (Fig. 1). Reviewing the existing data, we found that the distance from the treating hospitals can influence the four different

aspects: stage at diagnosis, appropriate treatment, outcome, and QoL.

### Travel Burden and Stage at Diagnosis

The role of travel burden influencing cancer stage at diagnosis was analyzed in 12 retrospective studies [1, 9, 13–22], which involved 401,775 patients (Table 1). All but three of these studies were performed in the United States. One study was done in the northeast of Scotland, one in Australia, and one in South Africa. Most of these studies included patients with breast, colorectal, lung, or kidney cancer or melanoma.

In 10 of these 12 studies, analyzing 387,639 patients, the travel burden conditioned the stage at diagnosis [1, 9, 13–15, 17, 18, 20–22]. Patients who traveled 50 miles or 1 hour or more in driving time were associated with a more advanced disease at diagnosis.

The same behavior was present in patients with poor geographical access or in patients of the rural area, who were twice as likely to have unstaged cancer (18.3%) than were urban residents (9.6%). Also, among patients with a known stage at diagnosis, rural patients tended to have more advanced disease than that of urban patients.

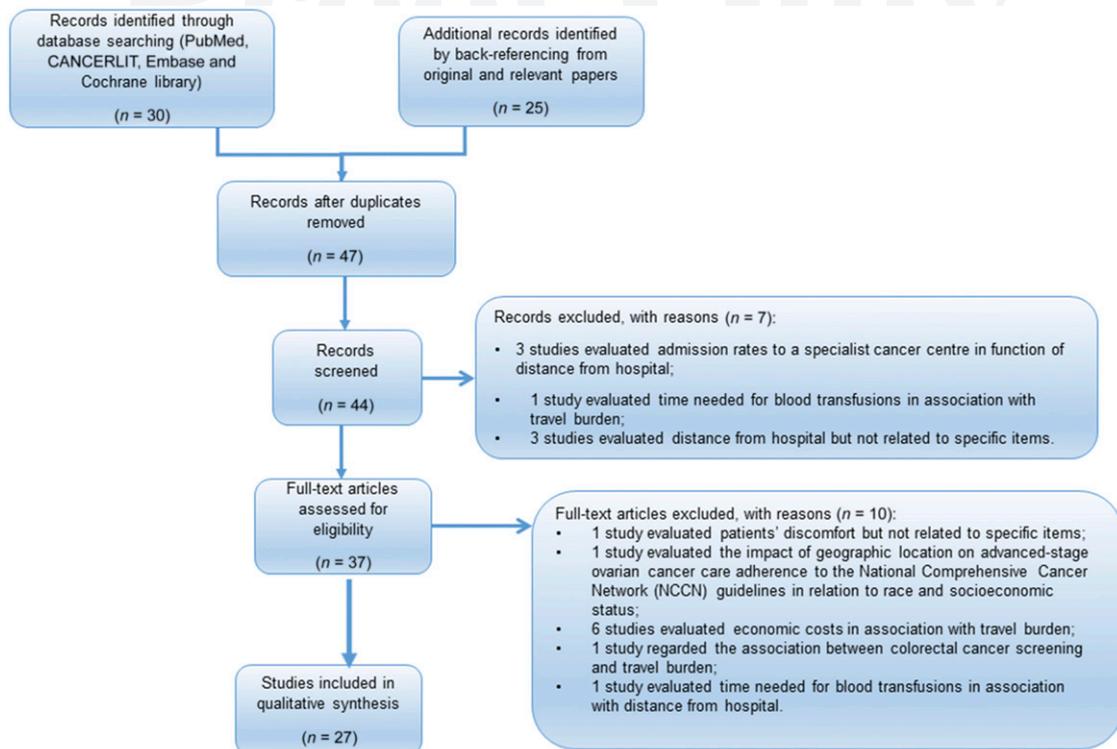
In only two studies, which exclusively involved women with breast cancer, was the travel burden not associated with an advanced stage at diagnosis [16, 19]. In patients with melanoma, for each 1-mile increase in distance, the Breslow thickness had increased by 0.6% [9].

It must be emphasized that these studies had some limitations. The main limitations (Table 1) included the methods used to calculate the travel time or distance; that in some studies, only 1 state in the United States was considered; the reliance on postal code data; that the data were obtained from a population-based cancer registry; and the inclusion of retrospective studies only.

### Travel Burden and Appropriate Treatment

Eight retrospective studies examined the travel burden and appropriate treatment (Table 2). All but one of these studies included female patients with breast cancer and were performed in the United States. The association between the travel distance to radiation therapy services and breast-conserving surgery (BCS), when indicated, compared with mastectomy for early breast cancer was analyzed. All these studies were performed in the United States and included 165,435 patients. All seven studies [23–29] demonstrated a statistically significant decrease in the likelihood of undergoing BCS among women with early-stage breast cancer living 15–20 miles or more from a hospital with radiation therapy services and a significant decrease in the likelihood of receiving radiotherapy after BCS. Thus, the distance was an important factor in women's decision-making in favor of mastectomy in situations in which breast-conserving surgery and radiotherapy could also have been a reasonable alternative.

The Australian study [30] included 3,240 patients with localized non-small-cell lung cancer (NSCLC). Patients who lived 100 km or more from the nearest accessible specialist hospital were more likely to have not undergone surgery (50.6%) than those living 0–39 km away. The main limitations of these studies (Table 2) included the use of a cancer registry and



**Figure 1.** Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram.

the consequent risk of incomplete data and the inclusion of retrospective studies only.

### Travel Burden and Patient Outcome

The relationship between travel burden and outcome was examined in four retrospective studies, including 144,470 patients (Table 3). Patients with diffuse large B-cell lymphoma (DLBCL) (British Columbia study) or with ovarian, rectal, or other cancers (Australian studies) were analyzed [7, 31–33]. These studies demonstrated that patients with lymphomas living in small and medium urban areas had worse overall survival (OS) than that of patients living in large urban areas [7].

The hazard of death from ovarian cancer was greater in women treated at a public general hospital than in women treated at a gynecological oncology service (GOS) [31]. The women were 19 times more likely to be treated only at a general hospital when they lived 180 km or more from a public GOS hospital than women who lived within 5 km of one. Patients living farther from a radiotherapy service were more likely to die of rectal cancer, with 6% increase in mortality risk found for each 100-km increase in distance from the nearest radiotherapy facility [32]. In addition, statistically significant differences were found in the relative excess risk of death across remoteness categories for cancer of the cervix and prostate and for all cancers [33]. The main limitations of these studies (Table 3) included the exact definition of the place of residence; the lack of knowledge of the type of treatment received by patients; that the availability of accurate data on cancer in indigenous people was lacking; and the inclusion of retrospective studies only.

### Travel Burden and QoL

Only one prospective study was found (performed in Ireland and including 496 colorectal survivors) that had analyzed the

association between travel burden and quality of life [6]. Patients living farther from treatment were associated with lower physical functioning and role functioning for women, who had also experienced more trouble with daily activities than did men. Remoteness also had a significant negative relationship with global health status for men. The limitations of that study were the low response rate to the survey (39%) and the younger age of responders compared with nonresponders.

### Treatment Compliance

In addition, the travel burden influences treatment compliance, as reported in two studies. A retrospective Indian study evaluated 144 patients affected by locally advanced cancer of the cervix in a rural medical college hospital. Of the 144 patients, 88 could not complete the treatment, and 63.89% were not able to travel more than 100 km from home to hospital for their treatment [34]. A prospective study performed in Texas analyzed 593 patients affected by breast, colon, cervical, or prostate cancer or lymphoma to determine the correlation between the distance and mode of transportation to radiotherapy and chemotherapy and the perceptions of transportation as a barrier to care [2]. They found that some patients might forgo necessary treatment because of problems with transportation, which was perceived as an issue more for minority patients (blacks and Hispanics) than for white patients [2].

### DISCUSSION

In the 21st century, oncologists are ready to deliver personalized medicine using the molecular profile of patients' cancer genome to optimize disease management. Also, as recently reported in the position paper by the European Society for Medical Oncology [35], at the center is the patient, with personalized

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**Table 1.** Travel burden and stage at diagnosis

Authors	Type of study	Patients (n)	Cancer type	Place and country	Results	Limitations
Scoggins et al. [1]	Retrospective	3,917	Breast, colorectal, and lung cancer	Washington, USA	One hour more in driving time or 100 miles more in driving distance associated with more advanced disease at diagnosis	Included only Washington state; no precise location data for all patients; travel time or distance calculated considering only private automobiles
Massarweh et al. [13]	Retrospective	296,474	Colon cancer	USA	Patients who traveled $\geq 50$ miles were more likely to present with metastatic disease	Only colon cancer patients; possible incomplete data
Celaya et al. [16]	Retrospective	5,966	Breast cancer	New Hampshire, USA	No association between travel burden and stage at diagnosis	Lack of knowledge about actual use of mammography facilities for screening; only New Hampshire state; later stage tumors not identified
Stitzenberg et al. [9]	Retrospective	615	Melanoma	North Carolina, USA	For each 1-mile increase in distance, Breslow thickness increased by 0.6%	Euclidean distance used; only North Carolina state; some mountains or coasted area not included
Parsons et al. [14]	Retrospective	3,286	Colorectal cancer	Maine, USA	Increasing distance to primary care provider associated with late-stage for colorectal cancer	Town-level distance to closest health care facility did not reflect distance to actual provider used; only Maine state.
Huang et al. [17]	Retrospective	12,322	Breast cancer	Kentucky, USA	Advanced diagnosis associated with longer average travel distances than early-stage diagnoses ( $p < .01$ )	Accuracy of geocoding data; assumption that women had access to mammography centers closest to their homes; only Kentucky state
Wang et al. [18]	Retrospective	30,511	Breast cancer	Illinois, USA	Poor geographical access to primary health care significantly increased the risk of late diagnosis for persons living outside Chicago	Results limited by reliance on postal code data; only Illinois state
Liff et al. [15]	Retrospective	37,899	Various malignancies identifiable through screening	Georgia, USA	Residents of rural area were twice as likely to have unstaged cancer (18.3%) as urban residents (9.6%); among patients with known stage at diagnosis, rural patients tended to have more advanced disease than urban patients	Data obtained from a population-based cancer registry; only Georgia state
Schroen et al. [19]	Retrospective	8,170	Breast cancer	Virginia, USA	No association found between travel distance and stage at diagnosis	Data collected from Virginia Cancer Registry; only Virginia state; some women could not adhere to screening programs
Campbell et al. [20]	Retrospective	1,323	Lung or colorectal cancer	North and northeast Scotland	Greater distance from a cancer center associated with more advanced (disseminated) disease at diagnosis	Limited statistical power to analyze each cancer separately; thus, data for both cancers were combined in some analyses
Dickens et al. [21]	Retrospective	1,071	Breast cancer	South Africa	Living just $> 20$ km increased the likelihood of late-stage cancer at diagnosis, a shorter distance than previously thought	Series was not a complete population-based sample
Satasivam et al. [22]	Retrospective	221	Renal cell carcinoma	Regional Australia	Greater distance from hospital associated with more advanced stage at diagnosis, $\geq T3$	Only one metropolitan and one regional center investigated

**Table 2.** Travel burden and appropriate treatment

Authors	Type of study	Patients (n)	Cancer type	Place and country	Results	Limitations
Schroen et al. [23]	Retrospective	20,024	Breast cancer	Virginia, USA	Mastectomy increased with distance to RT facility	Straight-line distance calculations used; cancer registry data primarily limited by incomplete collection of data for outpatient cancer treatment
Celaya et al. [24]	Retrospective	2,861	Breast cancer	New Hampshire, USA	New Hampshire women with early-stage breast cancer were less likely to choose BCS if they lived further from RTF; of those electing BCS, RT was less likely to be used by women living >20 miles from RTF ( $p = .002$ ) and those diagnosed during winter ( $p = .031$ ).	Procedures used by NHSCR to collect data
Voti et al. [25]	Retrospective	18,903	Breast cancer	Florida, USA	Distance to closest RTF negatively associated with BCSR in favor of mastectomy	Euclidean distance used; potential discrepancies between registry-recorded treatment and actual treatment administered
Athas et al. [26]	Retrospective	1,122	Breast cancer	New Mexico, USA	Likelihood of receiving RT after BCS decreased significantly with increasing travel distance to nearest RT facility	Data collected from cancer registry; possible incomplete data
Meden et al. [27]	Retrospective	66	Breast cancer	Northern Michigan, USA	BCS usage correlated negatively with travel distance	Possible confounding factors
Nattinger et al. [28]	Retrospective	17,729	Breast cancer	USA (not Hawaii)	Statistically significant decrease in likelihood of undergoing BCS among women residing $\geq 15$ miles from hospital with RTFs	Patients from National Cancer Institute's Surveillance, Epidemiology, and End Results registry national public-use database
Boscoe et al. [29]	Retrospective	104,730	Breast cancer	USA	Women traveling >75 km for treatment were $\sim 1.4$ times more likely to undergo mastectomy than those traveling <15 km	Data from central cancer registries; calculation of distance
Tracey et al. [30]	Retrospective	3,240	Localized NSCLC	New South Wales, Australia	Patients who lived $\geq 100$ km from NASH were more likely (50.6%) to not undergo surgery than those living 0–39 km	Data collected from cancer registries

Abbreviations: BCS, breast-conserving surgery; BCSR, breast-conserving surgery combined with RT; NASH, nearest accessible specialist hospital; NHSCR, New Hampshire State Cancer Registry; NSCLC, non-small-cell lung cancer; RT, radiation therapy; RTF, RT facility.

medicine offering the promise of delivering safe and efficacious target cancer treatment.

However, oncology care must also aim at improving the quality of life of cancer patients and giving patients and their families the possibility to realize their full potential, whether the cancer is curable or not. In this context, oncologists cannot ignore the problems related to the travel burden of cancer patients.

In the present review, we found that the distance from the hospital, or the travel burden, had a negative impact on patients affected by cancer, in terms of the stage at diagnosis, appropriate treatment received, prognosis, and QoL. In almost all the studies analyzed, patients who lived far from hospitals and had to travel more than 50 miles had a more

advanced stage at diagnosis, lower adherence to encoded treatments, a worse prognosis, and a worse QoL. These four aspects are all very important for patients and for health care policies and costs.

In almost all the studies analyzed, patients who lived far from hospitals and had to travel more than 50 miles had a more advanced stage at diagnosis, lower adherence to encoded treatments, a worse prognosis, and a worse QoL.

We realize that a publication bias could be present, because the studies reported in our review were almost all positive.

**Table 3.** Travel burden and patient outcome

Authors	Type of study	Patients (n)	Cancer type	Place and country	Results	Limitations
Lee et al. [7]	Retrospective	1,357	DLBCL	British Columbia, Canada	Patients in small- and medium-size urban areas had worse OS than patients in large urban areas	Exposure (place of residence) defined using a census definition of population areas with cutoffs not developed for this particular study type; definition of distances to treatment
Tracey et al. [31]	Retrospective	3,749	Ovarian cancer	New South Wales, Australia	Hazard of death from ovarian cancer was greater in women treated at nearest public general hospital than in women treated at farther GOS hospital	Cancer registry records linked to hospital records
Baade et al. [32]	Retrospective	6,848	Rectal cancer	Queensland, Australia	Patients living farther from RTF were more likely to die of rectal cancer, with 6% increase in mortality risk for each 100-km increment in distance from nearest RTF	Lack of knowledge of treatment type received; distance and time calculations based on closest RTF, not the actual facilities at which patients received treatment; true mortality attributable to the cancer could have been underestimated
Jong et al. [33]	Retrospective	132,516	All cancers	New South Wales, Australia	Statistically significant differences in relative excess risk of death across remoteness categories for cancer of the cervix and prostate and all cancers	Data collected from NSW Central Cancer Registry; accurate data on cancer in indigenous people not available in NSW

Abbreviations: DLBCL, diffuse large B-cell lymphoma; GOS, gynecological oncology service; NSW, New South Wales, Australia; OS, overall survival; RER, relative excess risk; RT, radiation therapy; RTF, RT facility.

However, we performed a narrative review of the published data, and we did not find other studies with negative findings, except those by Celaya et al. [16] and Schroen and Lohr [19].

The cancer stage at presentation significantly influences treatment planning, as well as the short- and long-term prognosis. A diagnosis at an earlier stage can allow for less-invasive, more efficacious, and less costly management [13]. The travel time also can be considered a direct cost of cancer treatment that is usually borne solely by the patients and their families. As such, the time costs associated with travel are an important component of the full economic burden of cancer. Travel can be of particular importance for socioeconomically disadvantaged persons, because the time costs associated with care can strain limited resources. Also, lower provider accessibility or transportation barriers can result in longer travel times for low-income individuals [1]. It is also reasonable to surmise that differences in the stage at diagnosis, for example, in the Breslow thickness for melanoma patients, could translate into differences in overall survival, even if these studies had not provided survival data [9].

The distance from the hospital (i.e., travel burden) also influences the choice of appropriate treatment by cancer patients. Some studies found that patients living farther from a radiation treatment facility more often underwent mastectomy instead of BCS [23–25, 27–29] or did not undergo radiotherapy after BCS [22, 24]. The results reported by Schroen et al. [23] suggest that a marked change in geographic access to radiotherapy by opening new facilities might correlate with an increase in the proportion

of patients undergoing breast conservation therapy. Tracey et al. [30] found that patients with localized NSCLC were most likely to not undergo potentially curative surgery if they lived far from a specialist hospital and only attended a general hospital for their care.

In addition, the distance of the residence from GOS hospitals in Australia was an important determinant of access to GOS hospitals, and treatment in a public or private GOS hospital and undergoing surgery were the strongest predictors of survival from epithelial ovarian cancer [31]. In the population-based cohort of patients with DLBCL reported by Lee et al. [7], the place of residence at diagnosis also significantly affected the health outcomes. Rural patients experienced OS and disease-specific survival similar to that of those in urban areas, in particular, large urban areas. However, patients living in small- and medium-size urban areas experienced worse outcomes.

Regarding the association between travel burden and QoL, the results of the study by Thomas et al. [6] suggest that remote colorectal cancer survivors, women in particular, have more trouble with daily activities, which was evidenced by their lower physical functioning scores. The lower role functioning scores for remote female colorectal cancer survivors suggest that they might feel unable to work or that they are limited in their ability to work.

The worse prognosis for patients living farther from treating hospitals could have been because the compliance with treatment or the follow-up program was suboptimal [34]. In addition, transportation to the health care provider can be

perceived as a barrier to care and can limit patients' compliance with treatment [2].

The worse prognosis for patients living farther from treating hospitals could have been because the compliance with treatment or the follow-up program was suboptimal.

It is well known that participation in randomized controlled trials is associated with improved cancer survival; however, many trials require frequent examinations. Thus, the travel burden can exclude patients from trials owing to the distance of their residence from the trial center. However, published data are lacking in this area, and further studies are required to explore this issue [36].

The review of the published data has shown that the more remote the area in which a person lives, the greater is his or her chance of dying from cancer. The worst survival figures were for areas where the proportion of indigenous persons is highest. The survival rates were particularly poor for those with cervical, prostate, head and neck, or colorectal cancer or melanoma [36].

Investigators have sought solutions to this problem. In Australia, Sabesan and Piliouras tried to find a solution to this problem with telemedicine [36]. Using telemedicine facilities, rural patients can have immediate access to specialist services without having to travel long distances. Chemotherapy can also be supervised with the use of this technology. The Townsville Hospital medical oncologists provide consultation to patients in the town of Mount Isa (a mining town approximately 800 km from Townsville) using videoconferencing. This allows cancer patients in Mount Isa to avoid the 10-hour drive or 2-hour flight to consult a specialist medical oncologist. The telemedicine clinics are conducted weekly; thus, urgent consultations can be arranged and treatment started within 1 week.

This method of service delivery also saves specialists many hours of travel time to examine 6–7 patients. Mount Isa doctors and nurses also receive one-on-one support and education from the medical oncologists by telemedicine,

and, most importantly, patients can be treated in their home town. A preliminary analysis by the Department of Medical Oncology at Townsville Hospital showed that most patients are satisfied with this service and that it allows the safe delivery of chemotherapy. However, one of the criticisms of telemedicine is the potential for missed information, leading to errors, because their study lacked information on the safety aspects of remote supervision of chemotherapy delivery. Audits are underway to address this concern [37].

In our region, we have developed a provincial oncological network. Thus, rural oncologic patients have ready access to oncological services, travelling a maximum of 30 km, at a unit of internal medicine and can be treated under the supervision of a medical oncologist who travels to the peripheral units. This network hosts a centralized unit for the preparation of anticancer drugs with a computerized system. A preliminary report has shown that oncologic patients can be treated with a minimal travel burden, achieving a cost-containment policy for the delivery of cancer care [38].

In conclusion, the results of the present review suggest that the travel burden is an important factor affecting access to appropriate and current cancer diagnosis and treatment and that it can worsen the achievement of universal high-quality care for cancer patients. The implications of an increasing travel distance should not be ignored. It has been reported that even a small increase in distance can result in a substantial barrier for this subset of the population [39].

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#### AUTHOR CONTRIBUTIONS

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**Manuscript writing:** Massimo Ambroggi, Claudia Biasini, Luigi Cavanna

**Final approval of manuscript:** Luigi Cavanna

#### DISCLOSURES

The authors indicated no financial relationships.

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A review of the published data on the role of travel burden influencing four items was performed. The results showed that increasing travel requirements are associated with more advanced disease at diagnosis, inappropriate treatment, a worse prognosis, and a worse quality of life, suggesting that clinical oncologists should remember the specific travel burden of cancer patients, who often need health care services every week or month for many years.

**Q: 1\_AU: Please verify all author names and affiliations.**

Q: 2\_AU: Per journal style, paragraphs consisting of a single sentence have been combined with the previous or next paragraph where possible. Please check throughout.

Q: 3\_AU: Per journal style, most nonstandard abbreviations must be used at least twice in the text to be retained; RER was used only once and has thus been deleted.

Q: 4\_AU: A new heading, "Treatment Compliance," has been added to separate this paragraph from the preceding subsection. OK as edited?

Q: 5\_AU: Please spell out AMOP in the Acknowledgments section if it is not the official name of the organization.

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