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A cost comparison study to review community versus acute hospital models of nursing care delivered to oncology patients

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ABSTRACT

Purpose: Ireland's Sláintecare health plan is placing an increased focus on primary care. A community oncology nursing programme was developed to train community nurses to deliver care in the community. While the initial pilot was proven to be clinically safe, no cost evaluation was carried out. This study aims to compare the costs of providing cancer support services in a day-ward versus in the community.
Methods: 183 interventions (40 in day-ward and 143 in community) were timed and costed using healthcare professional salaries and the Human Capital method.
Results: From the healthcare provider perspective, the day-ward was a significantly cheaper option by an average of €17.13 (95% CI €13.72 - €20.54, $p < 0.001$). From the societal perspective, the community option was cheaper by an average of €2.77 (95% CI -€3.02 – €8.55), although this was a non-significant finding. Sensitivity analyses indicate that the community service may be significantly cheaper from the societal perspective.
Conclusions: Given the demand for cost-viable options for primary care services, this programme may represent a national option for cancer care in Ireland when viewed from the societal perspective.

1. Introduction

Cancer is one of the leading causes of morbidity and mortality across the world. An estimated 18.1 million new cancer diagnoses and 9.6 million cancer deaths were reported by the Global Cancer Observatory in 2018 estimates(Bray et al., 2018). Cancer incidence is estimated to double by 2035(Bray et al., 2018) and with that both the costs and demands of oncology services will similarly increase. As a result, healthcare providers such as the Health Service Executive (HSE) are seeking ways to either (i) directly reduce costs of cancer care or (ii) moving the provision of health care interventions from the secondary care setting to the primary and community care sectors (Rischin et al., 2000; Lowenthal et al., 1996; Sprandio, 2012), in order to reduce the pressures of an increasing cancer patient population and to reduce the cost associated with the provision of care, as well as to ease the difficulties placed on patients facing long journeys for their cancer care.(Hall and Lloyd, 2008).

Nurse-led interventions have become increasingly common as a way of enhancing the efficiency of care and improving resource-utilisation in the healthcare system. As an increasingly specialised profession, there are many opportunities for nurses to expand their roles within all sectors of healthcare provision. The literature reports that nurse practitioners are clinically effective (Newhouse et al., 2011) and cost-effective (Martin-Misener et al., 2015) in healthcare provision and role expansion. Increased training for nurses has allowed for new enhanced services to be provided for the patients' benefit, with the healthcare provider and society also benefiting. Specialist cancer nursing interventions have shown enhanced patient outcomes, experiences and improvement in cancer management, in terms of both clinical and cost outputs(Lewis et al., 2009; Aiken et al., 2014; Corner et al., 2013).

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Patients value communication, nursing experience and personal education while receiving care, which oncology nurses have been shown to demonstrate(Griffiths et al., 2012).

The study was conducted in a catchment area of 22,572 km^2. This leads to long journeys and poses problems for patients looking to access services located centrally in hospitals. Oncology patients deal with many challenges in receiving their care, such as disruption of work, social life, psychiatric disorders (Derogatis et al., 1983), depression, (Spiegel and Giese-Davis, 2003) anxiety (Stark and House, 2000) and a general decline in quality of life(Heidrich et al., 2006). There is also a demonstrated strain on the family caregiver of those who receive oncology care (Stenberg et al., 2010). It should be incumbent to provide such people with every possible opportunity to improve both the quality and accessibility of their care. One such method is introducing oncology care to the community setting. Initiatives in USA (Lowenthal et al., 1996), Australia (Rischin et al., 2000) and in the United Kingdom (Hall and Lloyd, 2008) have shown success, in terms of patient preference, quality of care and cost, in moving oncology care services from secondary to a primary care setting. A recent study in USA has shown a decreased patient expense for those receiving oncology care in primary care rather than in secondary care setting(Gordan et al., 2018).

In 2010, a community oncology nursing programme was developed in response to service pressures within acute Medical Oncology Departments in Ireland. The programme enables community nurses to provide shared nursing care to acute oncology patients at home and in primary care centres. The nurses first completed a specifically tailored Level 9 University-accredited education course. A pilot program of this initiative has been evaluated and was found to have had a positive impact on (i) patients, through a qualitatively demonstrated improvement on quality of life and (ii) community and acute hospital-based oncology services, showing enhanced integration of patient care, both assessed qualitatively(O'Toole et al., 2013). The programme was introduced to HSE Community Healthcare Organisation (CHO) Area 2 (Health Service Executive, 2014) and there has been an ever-increasing demand on the community oncology service since. Table 1 below indicates the number of community oncology interventions in Galway in the last 3 years. The large increases in services provided between January and June 2019 can be attributed to an increase in the level of trained nurses, allowing for further roll out of safe primary care services. Costings were not undertaken in the initial evaluation as there was only a small volume of patients involved in the piloting of this programme. Hence, it was deemed necessary to complete a cost-comparison analysis of this new programme, before further roll-out was implemented nationally.

Ireland is in the process of implementing a 10-year plan for health reform called Sláintecare. The aim is to establish a universal, single-tier health service as well as re-structuring the health system "towards integrated primary and community care that is consistent with the highest quality of patient safety in as short a time-frame as possible"(Burke et al., 2018). There is an aim to move health services into primary care where possible. The community oncology programme examined here aims to provide both a safe and viable method of delivering cancer services in the community instead of providing the same care within an oncology day-ward of an acute hospital. This was the first study of its kind to the best of the author's knowledge.

Table 1
Number of community oncology services in Galway.

Time Period	5-FU disconnection pump	Other oncology services	Total
January 2017 – June 2017	349	693	**1042**
July 2017 -December 2017	369	657	**1026**
January 2018 – June 2018	330	715	**1045**
July 2018 – December 2018	388	762	**1150**
January 2019 – June 2019	435	1353	**1788**

2. Methods

This study utilised a micro-costing approach to calculate costs in the hospital and community settings, both from the healthcare provider's perspective and the societal perspective in Ireland during the latter months of 2019. Micro-costing is a type of costing method involving the direct enumeration and costing out of every input consumed during an intervention(Weinstein et al., 1996). It has become the gold-standard of costing methods due to its precise nature. Studies comparing the cost estimates made by micro-costing studies versus gross costing studies, whereby average costs are identified per treatment group (Drummond et al., 2015), have shown that micro-costing methods produce superior results, especially in the context of this study that takes place in a hospital and where the main driver of cost is labour-related costs(Clement et al., 2009; Tan et al., 2009; Wordsworth et al., 2005; Swindle et al., 1999).

2.1. Study sites

2.1.1. Hospital

The oncology day ward that was costed as part of this study is a University teaching hospital in the west of Ireland, with 521 beds providing a range of specialities. Patients are assessed and manages and treatment and interventions include chemotherapy, adjuvant therapies, 5-Flurouracil (5-FU) pump disconnections, catheter insertion supportive care and dressings.

2.1.2. Community

The community service was costed in two counties in the west of Ireland (Galway and Mayo). For each county, a community nurse who has completed the community oncology education programme is responsible for a given area and population. Patients in this area are given care in either Primary Care centres located in the given area, or in the patient's own home depending on certain circumstances.

2.2. Intervention

Several oncology interventions have been deemed suitable to be delivered in the community. Governance over the patient population and the interventions which can be delivered in primary care rests with the consultant and his/her cancer team in secondary care. The nurses carried out interventions such as 5-FU pump disconnections, PortaCath flushes, the care of Peripherally Inserted Central Catheter (PICC) lines and Hickmann lines, head-to-toe patient assessment and other auxiliary oncology services such as medication administration, medication management and blood sampling. These services were carried out under HSE best practice and values, in accordance with the community oncology nursing programme resource book (available on request).

2.3. Process mapping

In order to carry out an accurate micro-costing, process maps were created for all sites involved in the study during 2019. This involved consultation with process leaders in the sites, these being the nurse managers, followed by direct observation of the patient and nursing pathways by the lead author (COM). The finalised process maps can be seen in Figs. 1, 2 and 3 below. The process maps were designed at a top-level manner, aiding in outline each step in the respective processes. This was needed to identify resource utilisation across all sites, at the start of the micro costing study.

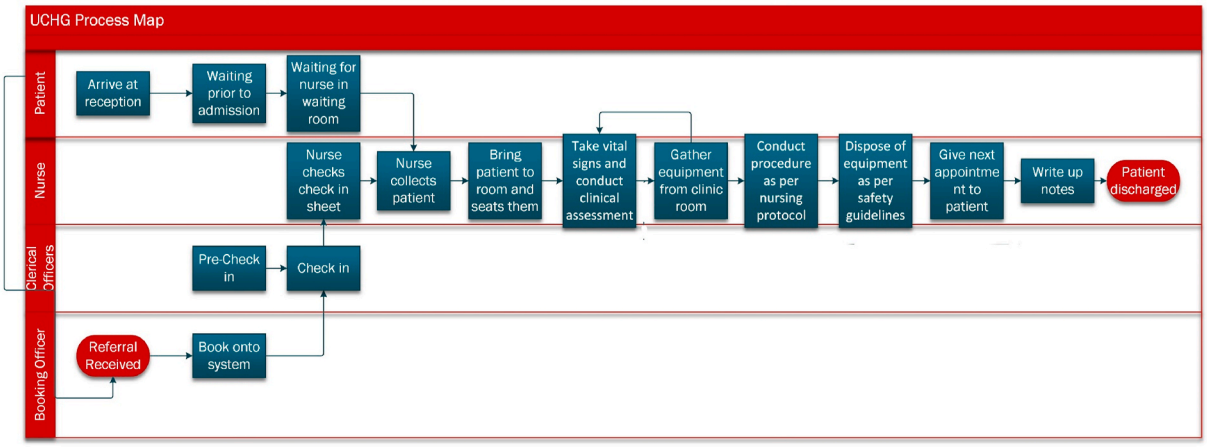


Fig. 1. Oncology day ward process map.

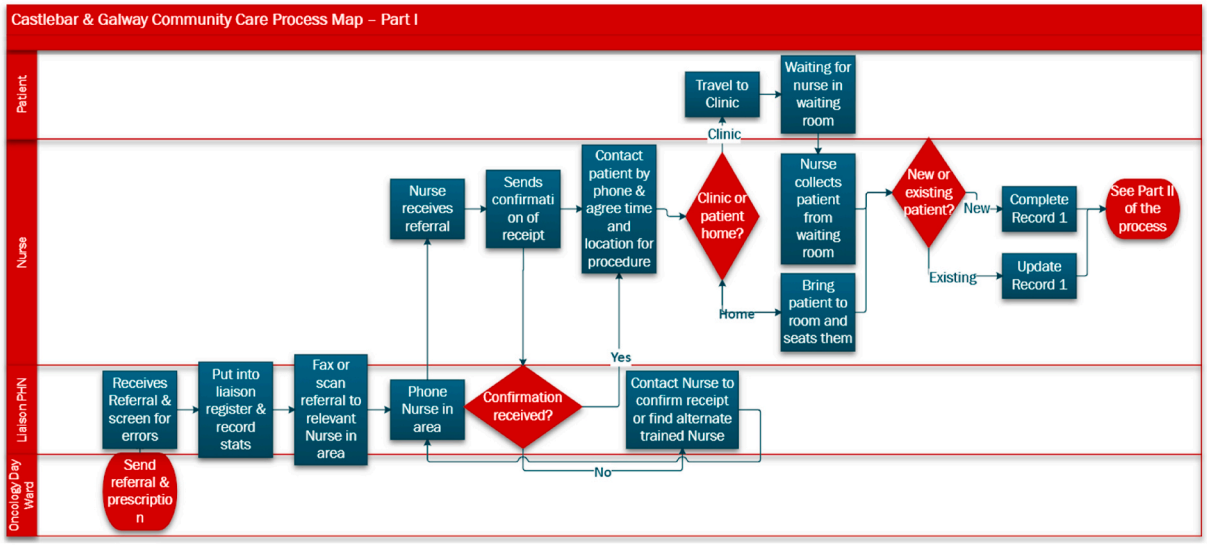


Fig. 2. Community care process map.

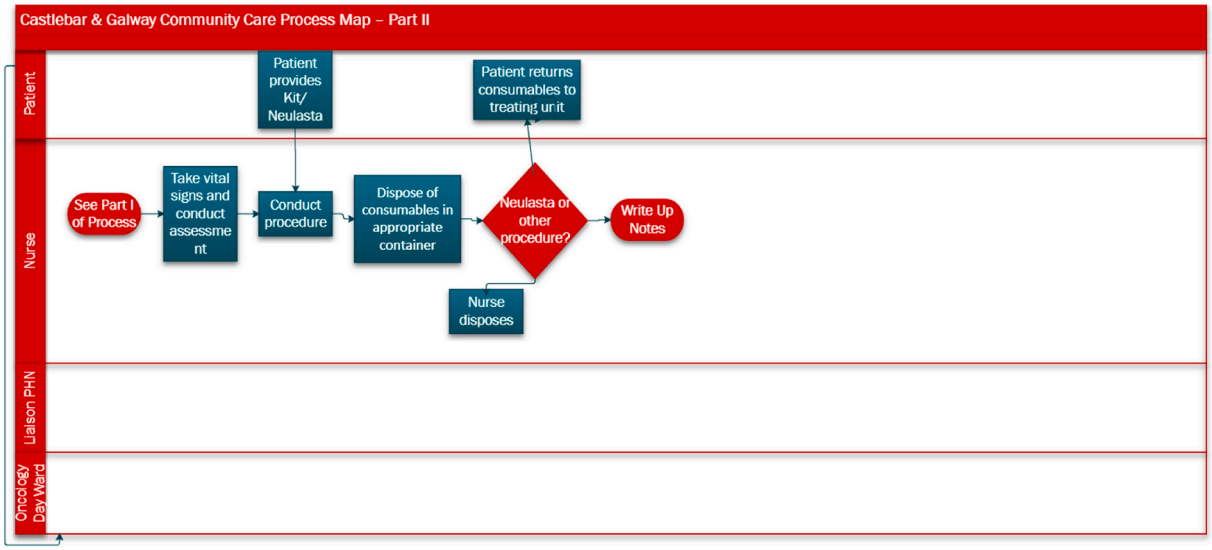


Fig. 3. Community care process map continued.

2.4. Cost-comparison analysis

A micro-costing approach was undertaken to accurately calculate costs. Both the healthcare provider and societal perspective were calculated, based upon available costs and measurements taken in 2019. Direct and indirect costs were calculated. Direct costs included healthcare professional time, expenses and consumable cost. Indirect costs included patient productivity time lost, travel costs and overheads. The currency used in all cases was Euro (€).

To calculate time-related costs, active time spent by nurses on carrying out tasks related to the patient's oncology care were recorded using a direct observation approach with a stopwatch. Patient-related time costs were calculated from total time spent waiting as well as travel time, using patient self-reported times. For nurses travelling to patients' homes, nurse travel time was recorded using an observation sheet and stopwatch (Appendix 1). The HSE healthcare professional pay scale (as per 2019) was used to cost the times observed. The midpoint of the relative professions pay scales (Health Service Executive, 2018) was used and adjusted for according to guidelines for economic evaluations in Ireland, (Health Information and Quality Authority, 2019) including pension payments, insurance and overheads. The hourly consultation rate was calculated by dividing the midpoint salary by the number of weeks worked per year and the number of hours worked per week. The number of weeks worked per year is 48 and the hours per week are 39. Public health nurse rates were applied to the community observations, and staff nurse rates were applied to the in-hospital day ward observations. Patient time-related costs were calculated using the Human Capital Method.(Van Den Hout, 2010) The average national hourly income as of 2019 Q2 (€23.81) was used.(Central Statistics Office, 2019) This method has been used previously to detail production loss in cancer (Norum et al., 2007; Stanisic et al., 2010). No discounting was needed given that the data collection period was carried out over 3 months. Similar methods of time-related cost calculation have been used by the study team previously(O'Brien et al., 2018, 2019).

The procedures that were costed were the head to toe patient assessment, 5-FU pump disconnection, PICC line dressing, PortaCath Flush, Hickman lines and some miscellaneous procedures. Nursing experts were consulted on the consumables used in each of these processes. The costs of consumables were determined by invoices issued from the finance department of the hospital involved in the programme in 2019. The resource utilisation and unit costs of consumable were used to calculate the total consumable cost for each process. This is outlined in Table 2. The cost of consumables used in the community are the same as those used in the hospital.

Total cost of a procedure was calculated from the public healthcare payer's perspective (HSE), by summing the total consumable cost and healthcare professional costs (procedure time, travel time, travel expenses), and the societal perspective cost, which was calculated by summing the cost of patient time and expenses to the health payer's cost.

There was no clinical data recorded in this study. This is because the pilot study for the Community Oncology Nursing Programme demonstrated no clinical difference in providing care in the two settings (19). During the evaluation period there were no adverse events reported among the patients who were treated at home by the PHNs. There were no emergency phone calls made by the PHNs to the mobile phone number that had been specifically available for consultations and enquires as well as emergencies. While there was no quantitative assessment of a change in patient quality of life, a qualitative assessment found an emphasis on the improvement of quality of life for patients treated in the community. The training provided by this programme is crucial to the viability of this project. The majority of the community nurses carrying out the interventions in the community would have no formal education specialising in oncology care prior to completing this programme. Without this programme, any cost study would need to detail clinical values for a cost-effectiveness study to be completed. Given that there was found to be no difference in clinical outcomes, comparing the costs incurred in both settings is enough to determine the viability of this intervention.

The costs in both settings were analysed graphically and formally using Kolmogorov-Smirnov and Shapiro-Wilks. Parametric data were compared using an independent sample two-tailed *t*-test, with α level 0.05 to test for significance. Levene's test for variance equivalence was used, and equal variance was not assumed if a significant result was found. For the cost-comparison analysis, the cost of consumables was excluded to remove it as a confounder i.e. The consumables used for each procedure do not vary between hospital and community settings. A cost-comparison analysis for procedures carried out in both settings was completed, as there were some procedures only observed in the community setting. The cost of community interventions in the two counties was compared using an independent samples *t*-test.

2.5. Sensitivity analysis

Although most day ward procedures are carried out by staff nurses, a portion of procedures are carried out by clinical nurse specialists. The costs incurred using a clinical nurse specialist hourly rate at levels of 5%, 10% and 15% involvement was calculated.(Health Service Executive, 2018).

Given that many cancer patients are too unwell to travel alone, a sensitivity analysis was undertaken to examine the impact of another person accompanying the patient on the social cost (without consumables) of the intervention. The cost of this person was calculated using the same Human Capital Method as the patient cost. To examine the variable effects of a patient being accompanied, 20%, 40%, 60%, 80% and 100% of the sample in all settings were analysed as if another person had accompanied them. For interventions carried out in the patient's home, no increase in cost was incurred, as there would be no need for an accompanying carer. The difference in cost between secondary and

Table 2
Consumables used per single procedure.

Items	Pump disconnection	Port Flush	PICC dressing	Hickmann Dressing		
				Single lumen	Double lumen	Triple lumen
Heparinised Saline 10 units per ml	1	1	2	1	2	3
Sterile posiflush syringe	1	2	4	3	4	6
Syringe luer lock	1	2	4	3	4	6
Sani Cloth	2	3	6	4	6	8
Sterile Dressing Pack		1	1			
NeutraClear Needle Free Connector		1	2			
Filter Needle	1	1	2	1	2	3
Gloves Surg Gammex		1	2	2	2	2
Dressing Opsite IV 3000			2	2	2	2
Gripper Needles		1				
Gauze square	2					
Opsite post op 6.5v5cm	1	1				
Chemotherapy gloves	2					

primary care interventions in this group was analysed using independent samples *t*-test.

2.6. Ethical considerations

Ethical approval was granted from the clinical research ethics committees of both the local hospital network and primary care network in the region (Saolta University Health Care Group C.A 2084).

2.7. Guidelines

This paper was reported in accordance with the International Society for Phramacoeconomics and Outcomes Research (ISPOR) Consolidated Health Economic Evaluation Reporting Standards (CHEERS) guidelines for reporting health economic evaluations(Husereau et al., 2013).

2.8. Software

Analysis was carried out using IBM SPSS Statistics Version 24 and Microsoft Excel 2016. Process maps were created using Microsoft Van Den Hout, 2010.

3. Results

Table 3 below details the cost of consumables as provided by the finance department used in each procedure identified in the process mapping exercise e.g. the costliest procedure was a Hickmann 2 dressing at €8.37.

3.1. 3.1 Healthcare professionals' cost

The annual salary midpoint for staff nurses is €38,546, resulting in an adjusted salary of €53,868 and an hourly consultation rate of €28.76. The annual salary midpoint for public health nurses is €54,888, resulting in an adjusted salary of €76,110 and an hourly consultation rate of €40.66.

3.2. Cost comparison analysis

A total of 183 procedures were analysed over the study period (between April and August 2019), 40 from the hospital setting and 143 from the community. Ideally an equal number of interventions would have been assessed across both settings but this was not feasible due to the lesser number of interventions that occur in the hospital. The number of each type of intervention is shown in Table 4.

As shown, some interventions were recorded only in the community setting. As such, an analysis of procedures recorded in both settings was deemed necessary.

Descriptive statistics of observations in each setting are shown in Table 5. Given all recordings were normally distributed, the mean and standard deviation are shown. Given that for the purpose of this analysis waiting time and travel time can be grouped together, these are combined in the variable additional time.

The cost of procedures from the healthcare payer's perspective was analysed. Equal variance was not assumed. The hospital setting was shown to be an average of €17.07 (95% CI €14.02 - €20.12, $p < 0.001$) less costly per procedure. When selecting only procedures done in each setting, equal variance again was not assumed and the hospital setting was an average of €17.13 (95% CI €13.72 - €20.54, $p < 0.001$) less costly per procedure.

For the societal perspective, equal variance was assumed. The community setting was cheaper by an average of €2.77 (95% CI -€3.02 – €8.55) per procedure, although this was a non-significant result ($p = 0.347$). When selecting only procedures done in each setting, a similar result was found, with the community setting being cheaper by an average of €3.47 (95% CI -€2.84 - €9.75), again a non-significant difference ($p = 0.278$).

Table 3
Consumables cost. The consumables used for each procedure do not vary between hospital and community settings. As such, it was excluded from the cost comparison analysis.

Procedure	Cost (€)
5FU pump disconnection	3.32
PICC line dressing	8.31
PortaCath flush	7.11
Hickmann 1 dressing	5.77
Hickmann 2 dressing	8.37
Hickmann 3 dressing	11.98

Table 4
Number of each intervention analysed.

	Hospital	Community	Total
5-FU disconnection	18	65	83
PICC line dressing	2	9	11
PortaCath Flush	18	7	25
Hickmann 1	0	0	0
Hickmann 2	0	8	8
Hickmann 3	0	9	9
Multiple procedures	2	13	15
Neulasta/Neupogen injections	0	26	26
Other	0	5	5
Missing	0	1	1
Total observations	40	143	183

Table 5
Descriptive statistics of observations.

	Hospital		Community	
Procedure time (minutes)	15.93 (9.95)		26.79 (14.99)	
Additional nurse time (minutes)[a]	0 (0)		10.39 (13.22)	
Additional patient time (minutes)[a]	45.03 (33.31)		10.35 (12.38)	
Nurse travel costs (€)	0		1.17 (2.02)	
Patient travel costs (€)	7.70 (7.24)		0.833 (1.67)	
Total cost (health payer) (€)	Not including consumables 7.83 (5.46)	Including consumables 13.51 (5.32)	Not including consumables 24.90 (15.11)	Including consumables 30.02 (14.99)
Total cost (societal) (€)	Not including consumables 32.46 (19.47)	Including consumables 38.14 (19.29)	Not including consumables 29.69 (15.38)	Including consumables 34.81 (15.22)

[a] Travel time + waiting time.

3.3. Home care versus primary care

The cost of providing the interventions in the primary care centre was significantly lower when compared to interventions in the patient's own home, from both the healthcare payer's and societal perspective. Equal variance was assumed in both comparisons. The primary care centre was an average of €15.36 (95% CI €10.83 - €19.89, $p < 0.001$) from the healthcare payer's perspective and an average of €7.59 (95% CI €2.44 - €12.73, $p = 0.004$) from the societal perspective.

Comparing the cost of only interventions carried out in the primary care centre versus those in the hospital, the hospital was found to be cheaper by an average of €5.69 (95% CI -€1.09 - €12.47) from the

healthcare payer's perspective, but this was not a significant difference (p = 0.098). From the societal perspective, the primary care centre was cheaper by an average of €11.15 (95% CI €8.49 - €13.89) (p < 0.001).

Table 6 below details the location of interventions carried out in the two counties. Comparing the cost of interventions in the two counties, interventions carried out in Mayo was shown to be an average of €6.96 (95% CI €1.88 - €12.02) cheaper from the health payer's perspective and €5.34 (95% CI €0.34 – €10.36) cheaper from the societal perspective (p = 0.008 and p = 0.034 respectively).

3.4. Sensitivity analysis

The salary midpoint of a clinical nurse specialist was €54,462, resulting in an adjusted annual salary of €76,706 and an hourly consultation rate of €40.975, resulted in a 41% increase in staff costs in the hospital setting. The societal cost of clinical nurse specialists carrying out 5%, 10% and 15% of procedures resulted in the community care being cheaper by €2.92 (95% CI -€2.82 – €8.76, p = 0.331), €3.10 (95% CI -€2.61 – €8.96, p = 0.317) and €3.22 (95% CI -2.42 – €9.08, p = 0.302) respectively. None of these findings were significant.

The cost of accompanying supporters of patients examined at rates of 20%, 40%, 60%, 80% and 100% of interventions is detailed in Table 7. Equal variance was not assumed for comparisons.

At all rates above 40%, there was a significant difference in mean cost, ranging from €8.66 (95% CI €0.96 - €16.36, p = 0.03) at 40%, to €15.90 (95% CI €7.61 - €21.20, p < 0.01) at 100%.

4. Discussion

This study showed that there is a significant cost increase in providing this service in the community from the health payer's perspective, with a mean difference of €17.07 p < 0.001). This was expected given the increased staff costs in travelling in the community. Nurse travel time was the primary driver in this cost increase, with average nurse travel time in all community interventions being 13.22 (±10.39) minutes, equating to €9.09 (+/−€7.14) in salary cost. The travel costs incurred also played a role in the increase. The average procedure time was significantly longer in the community (p < 0.001), even when examining only similar procedures. This may be due to the additional public health role of the nurses delivering the oncology care, as described in the community oncology handbook (available on request).

This study captured the societal perspective by calculating the loss of productivity via the human capital method as well as the health care payer perspective. Sanders et al. recommended for the sake of consistency and comparability, analysts should report "reference cases" from 2 perspectives— the health care sector perspective and the societal perspective(Sanders et al., 2016). This was also corroborated by an ISPOR Special Task Force report (Garrison et al., 2018). When using the societal perspective, this study found that there was no significant difference in the cost of delivering the oncology services between the two settings. A non-significant cost reduction of €2.77 (p = 0.278) when delivering interventions in the community was discovered. The primary reason for this change compared to the health payer's perspective is the reduction in patient travel time. The patient travel time is reduced by an average of 35 min (95% CI 27.97 min–41.38 min). This finding may be as important as the cost-saving from the health payer's perspective, given that a central aim of Sláintecare is an accessible and affordable healthcare system for all, with an increased focus on patient-centred care(Burke et al., 2018).

Table 6
Location of community interventions.

	Primary Care Centre	Patient's home	Missing	Total
Galway	22	39	1	62
Mayo	34	38	0	82
Total	56	87	1	144

Table 7
Cost of patient accompaniment.

% of patients being accompanied	Mean social cost € (SD)		Difference in cost (€)
	Hospital	Community	
0	32.46 (15.38)	29.69 (15.38)	2.77 (p = 0.432)
20	35.69 (21.22)	31.32 (15.67)	4.37 (p = 0.115)
40	43.63 (31.98)	34.97 (16.01)	8.66 (p = 0.025)
60	49.50 (32.55)	35.04 (16.76)	14.46 (p = 0.016)
80	52.31 (32.87)	36.99 (17.39)	15.33 (p = 0.008)
100	55.36 (33.20)	39.45 (19.85)	15.90 (p = 0.006)

The analysis of the different primary care settings showed the expected result that the primary care centre was a cheaper option for the health payer, being an average of €15.36 (, p < 0.001) than the patient's home. The primary care centre was found to be an average of €5.69 (95% CI -€1.09 - €12.47) more expensive than the hospital from the health payer's perspective but not significantly (p = 0.098). This may be because the community nurses were recorded in some instances to be travelling back to the centre after dealing with a house call. From the societal perspective, the primary care centre was significantly cheaper than the hospital, by an average of €11.15 (95% CI €8.49 - €13.89, p < 0.001). It is important to note that as part of any oncology primary care package home visits will be a necessity. Given their condition, certain patients require a home visit. This finding does show that from a societal perspective, interventions given in a primary care centre close to a patient's home represent a significant cost reduction, before even considering the improvement in access to services from the patient's viewpoint.

While all analyses indicated that providing the intervention in the community resulted in a significant cost increase for the health payer, the sensitivity analyses demonstrated that there is a possibility that providing this cancer care in the community represents a cheaper alternative from the society perspective. Frail oncology patients are often accompanied for travel and support reasons. This study found that in a scenario where a randomly selected 40% of the patients in both settings were accompanied by another person, a significant cost reduction of €8.66 (95% CI €0.96 - €16.36, p = 0.03) was observed. This trend continued the more patients that were accompanied. Unfortunately, the study did not record if someone had travelled with the patient or not.

When viewing from the societal perspective, these are welcome findings for the development of oncology care in Ireland. Providing oncology support services in the community is in line with the aims of Sláintecare, and this study shows that this represents a viable economic option. By moving these services away from oncology day unit within busy acute hospitals, there would be benefits for all. The freed-up space in the oncology would allow for more of the treatments that can only be provided in the day unit, such as chemotherapy. In addition to the economic benefits, there may be a quality of life benefit for the oncology patient by providing these interventions in the community, due to a reduced risk of infection associated with travel to hospital(Plowman, 2000). Patients have stated their preference for receiving oncology care in their own home(Rischin et al., 2000). The reasons include avoidance of travel and parking problems, reduction in hospital-associated anxiety, feeling of comfort in their own home and not burdening their carers and family.

Given that these oncology support interventions can be provided in a cost-effective manner, there may be scope for expanding the duties of community nurses to include other oncology services. The UK has long

allowed for chemotherapy to be administered as part of primary care (Lennan et al., 2010). Even if only the less complex interventions were handled in the community, this would further reduce the demands on the day wards within our acute hospitals. There is also appetite amongst both patients and nurses for blood samples to be collected in the community to streamline the chemotherapy administration process.

All interventions analysed were from two counties in the West of Ireland. One of the counties is particularly sparsely populated. This may skew the travel times of both patients and nurses, as many other counties in Ireland may have primary care centres and hospitals available at a shorter distance. The average distance to healthcare facilities can be up to seven times larger in rural areas than urban areas.(Central, 2016 Table 8 below shows the population density of the counties in the study compared to other Irish counties.

This study used time recordings across community and hospital settings to compare the cost of delivering oncology support services. A micro-costing methodology was used. Other studies in this area have shown some differing results, albeit with different methodologies and focuses. Rischin et al. used direct and indirect costs based on services received and found that the average chemotherapy treatment was $83 more expensive to deliver in the community than in hospital(Rischin et al., 2000). Gordan et al. discovered a significant decrease in cost per patient per month when delivering care in community oncology clinics compared to hospital clinics, primarily driven by the increased cost of chemotherapy and provider visits in hospital-based clinics(Gordan et al., 2018). No previous study of this kind has used the precise, micro-costing method of cost collection used in this study.

4.1. Limitations

The only costs estimated in this study were the costs incurred in the carrying out of the oncology interventions. The cost of training in the Community Oncology Nursing Programme is not included in this analysis. If this cost were included, it would favour the hospital setting. However, given that this is a lifelong qualification, it may be biased to include the cost of training when analysing the sample of interventions recorded. If it was included, the average cost per intervention carried out by a trained community nurses over the duration of her career would be negligible.

Ideally, a larger number of interventions would have been analysed for more robust results. These would ideally have come from the hospital setting to get more equitable sample sizes to compare, and thus provide more precise comparisons. However, where possible these support services were carried out in the community to free up needed space in the day unit, an imbalance in the proportion carried out in the community compared to the hospital was expected.

The sensitivity analyses were needed due to a lack of information regarding the type of staff who carried out the intervention and if the patient was accompanied by another person. The sensitivity analysis attempting to assess the impact of patients being accompanied to the hospital by carers only assessed accompaniment to the hospital. While the journey to the community centre may be less arduous, it is possible that the patient could be accompanied by a carer in that circumstance.

5. Conclusion

This study has shown that providing oncology support services in the community in Ireland can be a viable economic option when viewed from the societal perspective. The community oncology nursing programme has demonstrated safety in its provision of these interventions in the community, this shows that the services that these trained community nurses provide may be a cost-effective service. Given previous studies have shown the preference for community interventions and with Ireland's increasing focus on building a health system emphasising primary care, this community oncology programme may provide an option in reducing the oncology demands in hospital.

Table 8
Population densities in Republic of Ireland.

County	Population	Population density (per km^2)	Rank (of 26)
Mayo[a]	130,507	23.3	25
Galway[a]	258,808	40.2	14
Dublin	1,347,357	1459.2	1
Louth	128,884	155.4	2
Kildare	222,504	131.0	3
Cork	542,868	72.3	5

[a] Study counties.

CRediT authorship contribution statement

Cian O'Mahony: Conceptualization, Methodology, Formal analysis, Writing - original draft, Project administration. **Kevin D. Murphy:** Validation, Writing - review & editing, Supervision. **Gary L. O'Brien:** Methodology, Writing - review & editing. **Joe Aherne:** Writing - review & editing, Supervision, Project administration. **Terry Hanan:** Conceptualization, Supervision. **Louise Mullen:** Conceptualization. **Maccon Keane:** Writing - review & editing. **Paul Donnellan:** Writing - review & editing. **Claire Davey:** Writing - review & editing. **Helen Browne:** Writing - review & editing. **Kathleen Malee:** Writing - review & editing. **Stephen Byrne:** Conceptualization, Methodology, Validation, Writing - review & editing, Supervision.

Declaration of competing interest

The authors have no conflicts of interest to declare.

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Appendix A. Supplementary data

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