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notes ASCO 20 virtual scientific conference
highlighting value based care with emphasis
on abstracts with important clinical and
economic impact ———

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a model comparing the value of broad next gen sequencing [NGS] based testing to single gene testing [SGT] in patients with non squamous non small cell lung cancer [NSCLC] in the united states abstract 9529

although EGFR and ALK single gene testing [SGT] is relatively common [$>80\%$] in the US, testing for less common actionable driver oncogenes [ADOs] is rare. patients with non squamous [ns] NSCLC should be tested for ADOs, and highly effective treatments may be available for these patients.

simulation was used to evaluate various levels of testing with SGT or NGS on the basis of life years gained [LYG] as well as cost per LYG. ADOs included in NGS: EGFR, ALK, ROS1, BRAF, RET, MET, NTRK. SGT: EGFR and ALK.

each incremental 10% increase in NGS instead of SGT produces 2630 additional LYG and a cost savings per LYG between -49\$ to -109\$. at the current 80% testing rate, replacing SGT with NGS would result in an additional 21,019 LYG with reduced cost per LYG of -\$599. increasing testing from 80% to 100% of eligible patients would increase LYG by 15,017 over the current state. if 100% of eligible patients were tested with NGS and every identified patient received treatment, the cost per LYG of this strategy would be 16,641.57\$.

in a hypothetical model where highly effective treatment is available to all identified patients with ADOs, broad NGS testing compared to SGT for EGFR/ALK leads to large gains in life years at reduced cost per LYG compared to SGT, supporting universal NGS testing of all advanced nsNSCLC patients. conversely, lower levels of testing or only testing for common ADOs [as is the current state] result in large numbers of patients being unidentified and not experiencing these benefits.

real world analysis of clinical and economic impact of 21-gene recurrence score [RS] testing in early stage breast cancer [ESBC] in ireland abstract 540

treatment of hormone receptor positive [HR+] ESBC is evolving and the use of chemotherapy [CT] is declining with use of the 21-gene RS assay. this validated tool predicts the likelihood of adjuvant CT benefit in HR+ ESBC. results from the TAILOR-x study suggest up to 70% of HR+ node negative ESBC patients may avoid CT with $RS \leq 25$.

the objectives of this study were to assess the clinical and economic impact of RS testing on treatment decisions using real world data. using TAILOR-x results, patients were classified low risk ($RS \leq 25$) and high risk ($RS > 25$). data was collected via electronic patient records. cost data was obtained via the national healthcare pricing regulatory authority.

963 patients were identified - 797pts [82.8%] had low RS, 159 [16.5%] had high RS, and 7 [0.7%] unknown RS. post RS testing 595pts [61.8%] had a change in CT decision; 586 changed to hormone therapy [HT] alone, and 9 from HT to CT. in total, 227pts [23.5%] received CT, and 3pts [0.3%] declined. RS assay use achieved a 69% change in treatment decision in patients and a net 61% reduction in CT use. *this resulted in savings of over €4 million in treatment costs. deducting the assay cost, net savings of over one million euro was achieved.*

ireland was the first public healthcare system to approve reimbursement for RS testing. over the eight year period of the study, a net 61% reduction in CT use in irish pts with HR+ ESBC was achieved with conservative net savings of over 1.000.000€.

clinical outcomes and economic burden for bladder cancer patients. an analysis from a swedish cancer registry abstract 5026

understanding the real world clinical outcomes and economic burden throughout the disease continuum could help to gauge the value of current treatments and future innovations for patients with non muscle invasive bladder cancer [NMIBC], muscle invasive bladder cancer [MIBC], and metastatic urothelial carcinoma [mUC].

patients diagnosed with bladder cancer in the stockholm gotland region between 2005-2013 were included and followed until may 31, 2015 or until death.

in follow up year 1

- median health resource utilization [HRU] cost per person year was 9228\$ for NMIBC and 30.470\$ for MIBC per patient
- median HRU cost per person year increased from 28.849\$ to 38.959\$ for MIBC-T2 versus MIBC T4 disease

3587 bladder cancer patients were identified [NMIBC-2728; MIBC-859]. median HRU cost per person year was estimated at 30.470\$ for MIBC versus 9228\$ for NMIBC in year 1. for MIBC-T2, T3, and T4, median cost per person year was 30.154\$, 33.917\$, and 38.959\$ in year 1, respectively. total health resource utilization [HRU] cost for the NMIBC and MIBC cohorts is provided in the table below.

despite limitations in data classification and reporting in the swedish bladder cancer registry this retrospective analysis provided real world clinical outcomes and economic disease burden for patients with NMIBC, MIBC and mUC over a 10 year period where treatment interventions were relatively consistent.

while this registry reflects practice patterns in sweden, there a could be applicability to the regions within europe and abroad

total HRU costs for patients with NMIBC and MIBC per follow up year [years 1 to 5].

Diagnosis	Follow-up year	No. of Patients	Person-Years	Total HRU Costs (US \$)
NMIBC	1	2,728	2,632	34,811,317
	2	2,531	2,393	14,867,314
	3	2,200	1,972	10,188,457
	4	1,765	1,574	7,323,923
	5	1,399	1,252	5,152,229
MIBC	1	859	666	21,083,790
	2	505	418	4,598,487
	3	338	280	2,082,339
	4	237	203	1,227,474
	5	178	156	693,829

telemedicine visits reduce time to biopsy, travel time and costs for interventional radiology patients abstract 2082

telemedicine has been utilized to increase access to care for patients in primary care practices and more recently, specialty practices. as the patient's acceptance of this practice has grown specialists have also begun to utilize telemedicine visits.

the purpose of the study was to test the hypothesis that adding a telemedicine clinic practice could decrease the time to biopsy, travel time and cost for interventional radiology [IR] clinic patients. telemedicine visits were performed by a physician or advanced practice provider at a single institution, academic medical centre to patients at three MSK regional locations in NY and NJ. there were 172 MSK regional site telemedicine visits. with a significant reduction in time from referral to biopsy for telemedicine visits compared to in person visits [12 vs 17 days]. additionally, a significant reduction in travel time for telemedicine visits vs travel time to manhattan for in person visits. telemedicine visit patients had to travel 367 less hours than an in person visit and saved a total of 11.222miles [18.060kms] that they did not have to travel. telemedicine patients accrued 14.652\$ in economic benefits due to reduced travel costs and lost wages from work. *telemedicine significantly reduced the time to biopsy, travel time and cost for interventional radiology patients compared to in person visits while also increasing access to care for patients and allowing for more efficient use of physician time and resources.*

the current pandemic has forced our healthcare system to incorporate digital practices into routine care - this abstract highlights the benefit for both the patient and healthcare professional.



do assumptions in health economic evaluations hamper drug uptake? abstract e19289

health economic studies of anti-cancer systemic treatments typically make strong assumptions regarding the number of drug lines received after initial therapy. this may have a substantial effect on health economic outcomes and impact drug reimbursement and uptake in practice. this study aims to quantify the real world systemic treatment patterns in four metastatic cancers using clinical registries to explore whether health economic assumptions are justifiable.

data from 4431 metastatic cancer patients were extracted from australian clinical registries: colorectal [COL, n = 3087], non small cell lung [LUN, n = 705], pancreatic [PAN, n = 459], and melanoma [MEL, n = 180]. a set of criteria was defined to consistently identify drug lines across the cancer specific registries - based on the type of drug [biological agent or chemotherapy], switches in chemotherapy regimen [whether a chemotherapy agent was added or removed] and the timing of such changes. consequently, the identified drug lines provide a more detailed view on treatment patterns compared to clinical treatment lines [defined by disease progression].

most patients started treatment after diagnosis: 77% [COL], 89% [LUN], 56% [PAN] and 79% [MEL]. for COL, LUN, PAN and MEL respectively, the proportion of patients starting a 2nd drug line was 51%, 60%, 19% and 24%, whereas 28%, 35%, 6% and 8% of patients started a 3rd drug line. in all cancers, patients were most likely to receive only a single drug line. for all patients, the median number of drug lines were COL: 2, LUN: 2, PAN: 1, MEL: 1.

these findings show that patients are most likely to receive a single drug line - considering this, most health economic analyses likely overestimate the intensity of drug treatment in metastatic disease, thereby underestimating the impact of initial treatment relative to downstream treatments. *this is likely to bias estimates of total treatment cost, cost effectiveness and budget impact, which will hamper the uptake of novel anti cancer agents and may lead to suboptimal decisions regarding treatment strategies.*

three versus six months of adjuvant chemotherapy for colorectal cancer. a multi country cost effectiveness and budget impact analysis abstract 7076

the international short course oncology treatment [SCOT] trial demonstrated non inferiority and significantly less toxicity of three versus six months of adjuvant chemotherapy for patients with colorectal cancer [CRC]. this study assesses the value of shorter treatment and the economic implications of implementing the findings from the perspective of the countries that participated in the SCOT trial [UK, denmark, spain, sweden, australia, and new zealand].

individual patient level data [n=6055] was used in a fully pooled, cost utility analysis for the six participating countries. the incremental net monetary benefit [INMB] per patient was calculated using a willingness to pay threshold of one gross domestic product [GDP] per capita for each country and responses to a clinician questionnaire were used to estimate extent of practice change. the budget impact over five years of using shorter treatment was calculated, using 2019 and US dollars [USD] as the base year and currency, respectively.

a large proportion of the difference between using three versus six months treatment is driven by hospitalization attendance costs in year one, although cost savings alone from chemotherapy medication use are also substantial. assuming 100% practice change to using three months for all patients diagnosed with stage III colorectal cancer, the total budget impact across all six countries over five years would provide savings of over half a billion USD. three versus six months of treatment is cost effective from the perspective of all six countries. even using a conservative estimate of practice change will lead to millions of dollars of savings. globally, it may be several times this estimate. the INMB per patient of using shorter treatment and subsequent monetary impact on healthcare provider budgets resulting from implementation are shown in the table below.

this is a cost saving treatment strategy in all countries with a budget impact over five years amounting to savings of nearly half a billion USD.

to explore a way of reflecting on and estimating the return on that investment, this study assessed two key research questions. 1- is three months of doublet chemotherapy cost effective compared to six months from the perspective of all countries that recorded to SCOT. and 2- as a way of thinking about return on the investment [ROI] into the SCOT trial, what is the likely impact on health care budgets if these findings are implemented in real life?

the incremental net monetary benefit for the three month arm of the trial versus six months ranged from approximately 11.000\$ USD for spain, to over 15.000\$ USD for denmark. the probability that three months of treatment was cost effective compared to six months was over 99% for every country, at a willingness to pay of one GDP per capita. the estimate budget impact for health care systems from implementation of SCOT trial findings over five years ranged from 6\$ million USD for new zealand to 171\$ million USD for the UK. these differences in part will be dictated by the number of patients diagnosed with colorectal cancer annually in each country. in total, these budget savings amount to 385\$ million USD across all countries.

the economic burden of CRC treatment globally exceeds 39\$ billion per annum. understanding the costs and consequences of widespread clinical practice change is important for optimal budget planning. this study has widened the transferability of results from a phase III cancer trial, showing shorter treatment is cost effective from a multi country perspective. the vast savings could provide benefit elsewhere within a limited healthcare budget, and justify the investment in conducting the SCOT trial.

future questions that could be explored include incorporating a societal perspective to the analysis by calculating cost savings from earlier return to work and less travel time to clinics with shorter treatment. it would also be useful to repeat this analysis for other multinational trials. this would open dialogue and allow wider reflection on the returns, monetary or otherwise, for health care systems, patients, and society from investing in cancer trials and the subsequent implementation of their results.

value based estimate of market size and opportunity for economic benefit through innovative pancreatic cancer [PC] therapies abstract e16790

over the past 20 years, cancer drugs have contributed to increased life expectancy, reduced mortality, decreased hospitalization and decreased use of medical services. the economic value of these improvements is about as large as the value of the increase in the US gross domestic product during that time period. recently, a health economic study presented at ASCO GI 2020 cited *that every 1\$ [adjusted for inflation] spent on innovative PC treatments reduced non drug expenditures by 9\$, thereby lowering the total cost of care for PC patients*. accordingly, the commercial opportunity of a new therapy should be measured by some combination of the clinical, economic and social value generated. the value of a novel PC drug from this perspective is demonstrated in this analysis..

analysis of SEER survival and incidence data between 2008 and 2016 shows the introduction of new medicines for PC of all stages was associated with a cumulative increase of 26.456 life years, or 2.52 life years per patient. it is also associated with quality of life [QoL] improvements, measured by a decline in hospitalizations rates and emergency room visits that can also lead to more days at work, at school and with family. several studies have suggested the average value of an additional year of life, for the age of a typical patient diagnosed with PC, is at least 250.000\$. using this figure, the value of 26.456 life years gained from 2008-2016 is 6.61\$ billion [26,456*250.000\$] to patients, the healthcare system and society, as a result of advancing medical innovation for patients with PC.

the median annual list price of a life enhancing cancer therapy is 150.000\$ per patient- using the NCI treatment prevalence estimator researchers estimated that between 2020-2025, there would be an additional 10,728 advanced PC patients requiring treatment who could benefit from innovative drugs. the total cost of these drugs for these patients would be 1.61\$ billion. however, the economic value of the life years saved would be 6.76\$ billion [10,728*2.52 life years*250.000\$ = 6.76\$ billion]. a review of cancer medicine payor coverage suggests a new PC therapy that produces such value would be able to obtain coverage from US payors given this value based price. therefore ***a value based approach to estimating the opportunity for clinical and economic benefit reveals significant potential for new PC medicines.***

economic burden of not testing for FLT3 to treat acute myeloid leukemia abstract e13652

acute myeloid leukemia [AML] is a hematologic neoplasm with poor 5 year survival [33%; US 2016], a median survival of only four months for relapsed/refractory cases, and in 2016, a US incidence of 19,950 cases and 10,340 deaths. with the largest patient cohort over 65, AML treatment costs in the first year are > 25.000\$ per patient per month [PPPM]; the initial month's cost is 82.328\$. mutations in the FMS-like tyrosine kinase 3 [FLT3+] pathway confer resistance to standard chemotherapy and reduce the likelihood of survival after relapse. in 2017 and 2018, the FDA approved midostaurin and gilteritinib, two current FLT3+ precision medicines for AML. here, researchers determine the economic burden of not testing for FLT3+.

AML healthcare costs were assessed and modelled for the following settings: hospital, outpatient, emergency, and primary care. pharmaceutical activity and cost data were extracted from the centres for medicare and medicaid services [CMS] database. the model forecasts the economic impact of precision testing to guide FLT3+ precision medicines in 2017 through 2019 and the algorithm calculated the number of AML patients with FLT3+ based on AML medicare patients in the healthcare cost and utilization project database and FLT3+ prevalence and switching data.

a total US 2016 AML costs were 1.574\$ billion, consisting of **i.** hospital care 1\$ billion [including 229\$ million for bone marrow transplantation and 20.5\$ million for pharmaceuticals]; **ii.** outpatient care 9.8\$ million; **iii.** emergency care 553.9\$ million; **iv.** primary care 6.6\$ million. analysis of CMS data revealed a paucity of FLT3+ testing to guide therapy. *it was estimated that after testing, 2,164 FLT3+ medicare patients could benefit from precision medicine interventions, generating 2,965 quality adjusted life years [QALYs] or 2,783 QALYs when administering midostaurin or gilteritinib respectively.*

this study is the most detailed analysis of the economic burden of AML among US medicare patients to date and is the only AML cost of illness study to incorporate data concerning patients' QALYs lost by failure to employ precision medicine. this study not only illustrates the minimal FLT3 testing conducted, but also the lack of precision medicines administered.

panel based methodology for assessing the impact of public policies on cancer patients and survivors abstract 12059

cancer interventions are subject to a range of regulations, but data from large, nationally representative surveys are not always available in time to inform the policy process and do not always address issues specific to cancer patients and survivors. understanding their experiences is

critical to achieving policy solutions to issues such as access to effective pain relief, reducing unexpected medical bills, and reducing the impact of high prescription drug costs on treatment for lower income cancer patients. this research intended to better understand patient experiences and opinions in a statistically valid manner specifically targeted to the policy process.

3057 panelists were identified from ACS contacts, health systems, and social media advertising to participate in a series of surveys across a year. the panel included diverse survivors across age, gender, race, ethnicity, economic status, and cancer type. online surveys were deployed semi monthly on cancer survivorship topics impacted by current policy, including access to/affordability of care, pain treatment, and prescription drug costs. responses were analyzed for the entire population and across subgroups of cancer survivors.

insights from cancer patient and survivor experiences helped support public policies through findings such as [but not limited to]: 41% of those prescribed opioids had trouble getting their medicine, creating difficulty participating in work, family, or social events; extra trips to the doctor or pharmacy; negative impact on treatment, and trips to the emergency room due to uncontrolled pain; 24% received a surprise medical bill, increasing their anxiety, reducing likelihood to see a specialist, and reducing likelihood to seek emergency care during a serious health issue; and 31% of those with household income less than 30,000\$ report trouble affording prescription drugs and 17% have delayed or not filled a prescription due to cost.

findings supported the policy process by helping craft policy positions aligned with cancer patient preferences, raising public awareness, and communicating to policymakers the impact of policies on cancer. *the panel methodology provides an **on demand channel to rapidly gather cancer survivor input on emergent and critical issues, such as the current COVID 19 crisis and illustrated the impact of policy decisions on cancer patients and survivors.** the findings provided an unprecedented level of input to the policy process for cancer patients and survivors through direct engagement with cancer survivors to understand their experiences and opinions - yielding valuable input to the policy making process.*

economic evaluation of the oncotype DX test for hormone receptor positive [HR+] early stage breast cancer [BC] from the brazilian societal perspective abstract e19380

selecting appropriate patients for adjuvant chemotherapy [AC] remains an important issue in BC treatment. although AC improves clinical outcomes, toxicity and economic burden is substantial. the oncotype DX test identifies high risk patients likely to benefit from AC who otherwise might not be identified through standard parameters [SP], and low risk patients unlikely to benefit from AC, avoiding toxicities and inherent risks. this study estimated the incremental cost effectiveness ratio and budget impact [BI] of oncotype DX testing from the perspective of the brazilian public health system.

as a societal perspective analysis, medical costs [test, AC, and adverse events], costs of productivity loss, transportation and employment leave were considered. population was estimated from BC incidence, proportion of early stage cases, and HR expression. an incremental proportion of 10% per year of patients using oncotype DX testing was assumed. BI analysis had a 5-year horizon and cost effectiveness a lifetime horizon [5% annual discount].

oncotype DX results as identifier of a subgroup at higher risk of relapse and greater benefit with AC was dominant over SP. oncotype DX testing resulted in clinical benefits in terms of life years gained [0.62] and quality adjusted life years [0.54], related to lower incidence of distant recurrence and use of AC, both of which greatly impacted quality of life. testing resulted in economic benefits, with lower average cost per patient [- 3.855BRL]. incorporation of oncotype DX testing resulted in potential savings reaching 107\$ million BRL in the 5th year stemming from the decrease in AC and consequent decrease in indirect costs.

patients with HR+, HER2- early stage BC may present different risks of relapse and likelihoods of benefiting from AC. with **high clinical impact for patients and high economic impact for the health system**, a tool that safely and accurately identifies the subgroup of patients who really need AC is essential. oncotype DX test incorporation in the brazilian public health system should be considered.

**IF BRAZIL CAN
BENEFIT FROM THIS TYPE
OF INTERVENTION- WHAT
WOULD THE IMPACT BE IN
CANADA**

real world clinical and economic burden associated with hospitalization in metastatic triple negative [ER-/PR-/HER2-] breast cancer abstract e19236

metastatic triple negative breast cancer [mTNBC] is associated with poorer disease prognosis and higher healthcare utilization and costs compared with other breast cancer subtypes, with hospitalizations being a major cost driver. this study aimed to understand reasons for hospitalization and describe the clinical and economic burden associated with hospitalizations in mTNBC patients following first line [1L] treatment initiation.

mTNBC patients were identified in the IQVIA real world data adjudicated claims US database [jan. 2012 - jan. 2019] and indexed on the day of 1L treatment initiation. women ≥ 18 years of age with mTNBC who had continuous enrolment for ≥ 12 months before [baseline] and ≥ 30 days after [follow up] index and no evidence of other primary cancers during baseline were included. patient baseline characteristics and all cause hospitalizations during follow up were described.

4,617 mTNBC patients were identified [99.7% with chemotherapy as 1L]; 1,595 [35%] had ≥ 1 hospitalization during follow up (mean duration 17 months). the average time from index to first hospitalization was 7.4 months and hospitalized patients had a mean of 2.4 hospitalizations per patient per year [PPPY], with mean length of stay of six days. 25% of hospitalized patients were admitted from the emergency department [ED]. reasons for hospitalization included

chemotherapy related adverse events [AEs; 76%], followed by disease progression [72%], breast related surgeries [6%], and others [4%]. common chemotherapy related AEs included infection or pyrexia [46%], anemia [35%], and neutropenia [17%]. total cost associated with hospitalization was 57.115\$ USD PPPY, with the annual out of pocket cost averaging 3659\$ per patient; mean out of pocket cost per hospitalization was 1840\$. the proportion of patients with hospitalization was similar between metropolitan and rural patients [35% vs. 37%], yet metropolitan patients had slightly longer hospital stays [mean 6 vs. 5 days].

approximately one third of mTNBC patients were hospitalized following 1L treatment initiation and in turn, bear a high economic burden. *new therapies are needed to mitigate the clinical and economic burden associated with hospitalizations in this population.*

health economic analysis of doublet chemotherapy with and without bevacizumab for first line treatment of RAS mutant metastatic colorectal cancer based on real world data abstract e16048

bevacizumab remains the dominant biologic treatment option for RAS mutant [RASmt] metastatic colorectal cancer [mCRC]. while the health economic impact of bevacizumab in the RASmt subpopulation may deviate from its use in the general mCRC population, this has never been investigated. this study uses the power of real world data to assess the cost effectiveness of doublet chemotherapy with, compared to without bevacizumab [chemBev and chemOnly, respectively] for first line treatment of RASmt mCRC, while accounting for subsequent treatment in second and third line.

data from the treatment of recurrent and advanced colorectal cancer [TRACC] registry was analyzed to populate a discrete event simulation of three treatment lines, surgery of primary tumour and metastases, hospitalizations following serious adverse events, and best supportive care. costs were included from an australian public payer perspective in australian dollars [AUD]. all health and economic outcomes were discounted at 5% per year. of the 507 included RASmt mCRC patients that started first line treatment in the 2010 – 2017 time period, 345 received chemBev and 162 chemOnly. the corrected median time on first line treatment was 7.1 months for chemBev and 4.1 months for chemOnly. time on second and third line treatment was comparable between the groups. corrected overall survival was 22.6 months for chemBev and 14.3 months for chemOnly. in terms of the health economic impact, mean life years were 1.9 for chemBev and 1.5 for chemOnly, and mean costs were 93.025\$ AUD and 44.929\$ AUD per patient, respectively. the resulting incremental cost effectiveness ratio [ICER] of chemBev compared to chemOnly was 149.317\$ AUD per life-year gained [LYG].

in contrast to results from clinical trials, overall survival was substantially longer for patients who received bevacizumab, which can possibly be attributed to an imbalance between groups despite correction for known prognostic factors. at an ICER of 149.317\$ AUD per LYG, the

economic burden of upfront treatment with bevacizumab was found to be substantial and consistent with estimates for the general mCRC population. this is mainly caused by the duration of first-line treatment, which was significantly longer for chemBev.

symptom burden as a predictor of emergency room use and unplanned hospitalization in patients with head and neck cancer. a population based study abstract 12084



patient reported symptom scores strongly predict emergency department use and unplanned hospitalization in head & neck cancer. head and neck cancer [HNC] patients consistently experience some of the highest rates of symptom burden among all cancer patients, though they remain undetected and untreated by clinicians in up to 50% of cases. integrating patient reported outcomes [PRO] within routine clinical practice has been suggested as a way to improve detection. in order to inform an effective and efficient PRO symptom screening program, researchers sought to determine whether outpatient symptom scores could predict emergency room use and unplanned hospitalization [ER/Hosp] in a cancer patient population.

this is a population based study of patients diagnosed with head and neck cancer who had completed at least one outpatient edmonton symptom assessment system [ESAS] assessment between january 2007 and march 2018 in ontario. logistic regression models were used to determine the relationship between reported outpatient ESAS scores and ER/Hosp use in the 14 day period following ESAS completion.

there were 11,761 unique patients identified with a total of 73,282 ESAS assessments. there were 5203 ER/Hosp outcome events. the odds of ER/Hosp use increased linearly with ESAS score corresponding to a 9.23 higher odds of ER/Hosp use for the maximum index ESAS score of 10. seven of the nine ESAS symptom scores were significantly associated with ER/Hosp use with pain, appetite and shortness of breath demonstrating the strongest association.

ESAS scores are independently associated with 14-day ER/Hosp in head and neck cancer patients and appropriate and timely management of symptom burden may reduce rates of ER/Hosp.



reimbursement recommendations for cancer drugs supported by phase II evidence in canada abstract e14133

historically, pharmaceutical companies submitted phase III evidence for consideration of public reimbursement; however, phase II data is being more commonly used as primary evidence. whether submissions with phase II data lead to similar rates of positive reimbursement

recommendations as phase III data has not been comprehensively investigated. researchers compared frequency of reimbursement recommendations between phase II and phase III submissions for oncologic drugs and assessed for factors associated with a positive or conditional recommendation.

all submissions with phase II data from the CADTH pCODR's expert review committee [pERC] recommendations from July 2011 to July 2019 were identified as well as 14 binary variables relating to clinical benefit, patient based values, economic impact, and adoption feasibility. using fisher's exact test to characterize associations between all variables and the final recommendation. multivariable analysis with logistic regression for three variables: feasibility of phase III study, hematologic indication, and unmet need were conducted.

139 submissions with a pERC final recommendation were identified -27 [19%] submissions were supported by phase II evidence, with 63% having a positive recommendation in comparison to 82% among submissions with phase III evidence. clinical benefit, gap in current treatment standards, and patient alignment were associated with a positive recommendation, whereas the future feasibility of conducting a phase III study was associated with a negative recommendation. no significant association was found between the recommendation and factors related to cost effectiveness or adoption feasibility. in multivariable analysis, only feasibility of a phase III study was significantly associated with a negative recommendation.

oncologic submissions with phase II data were less likely to be recommended for public reimbursement than phase III studies. positive or conditional recommendation was more likely if they demonstrated clinical benefit and aligned with patient values. pERC was less likely to recommend a submission with phase II if a phase III trial was either possible or already initiated.

a comparative study on costs of cancer and access to medicines in europe abstract e19051

cancer care is evolving rapidly, and costs and value of new treatments are often causing headlines without being discussed in a larger context. this study estimates the cost of cancer and access to medicines in europe in 2018 and extends a previous analysis for 1995-2014.

cancer specific health expenditure for 31 countries [EU-27 plus iceland, norway, switzerland, and the UK] were derived from national estimates. data on cancer drug sales were obtained from IQVIA. the productivity loss from premature mortality was estimated from data from eurostat and the WHO. estimates of the productivity loss from morbidity and informal care costs were based on previous studies.

the total cost of cancer was 199€ billion in 2018. total costs ranged from 160€ per capita in romania to 578€ in switzerland [after adjustment for price differentials]. health expenditure on

cancer care was 103€ billion, of which 32€ billion was spent on cancer drugs. informal care costs were 26€ billion. the total productivity loss was 70€ billion, composed of 50€ billion from premature mortality and 20€ billion from morbidity. between 1995 and 2018, cancer incidence increased by 50% from 2.1 million to 3.1 million cases in europe. cancer mortality increased only by 20%. health spending on cancer care doubled from 52€ billion to 103€ billion [in 2018 prices and exchange rates], whereas the share of cancer care on the total health expenditure remained stable at around 4-7%. a shift from treatment in inpatient care to ambulatory care has probably saved costs. expenditure on cancer medicines more than tripled from 10€ billion to 32€ billion between 2005 and 2018. [excluding confidential rebates]. productivity loss from premature mortality decreased over time, linked to mortality reductions in working age patients.

there are large country differences in spending on cancer care and outcomes in europe. access to new cancer medicines is low or very low in certain parts of europe. *inequalities are mainly related to countries' economic strength and not to the disease burden of cancer.*

the potential of a CLIA certified prognostic | predictive molecular test to address the rising costs of non small cell lung cancer abstract e21671

treating recurrences of non small cell lung cancer [NSCLC] is increasingly expensive but still rarely curative. disease free survival [DFS] among resected stage I-IIA patients remains only 50-70%. guidelines advocate adjuvant therapy in "high-risk" patients in this population to reduce these costly and deadly recurrences, but recognize that conventional criteria have not been validated to stratify risk or predict benefit. a CLIA-certified, commercially available 14-gene expression risk profile [determaRx] has been extensively validated among stage I-IIA non-squamous NSCLC patients; prospective data now suggest that the test predicts improved DFS with adjuvant therapy and therefore researchers studied the potential economic impact of this molecular test on early stage NSCLC.

model variables included: relative increase in DFS with adjuvant treatment of molecular intermediate and high risk patients; cost of adjuvant [8760\$; 8144\$-9376\$] or late stage [284.500\$; 224.900\$-345.200\$] treatment; and compliance with recommendations for adjuvant therapy.

reduction of recurrences with implementation of the 14 gene assay resulted in an average cost savings of 11.608\$/patient [potential systems savings of ~450\$ million], even when including the cost of molecular risk stratification [4000\$/patient] and of cisplatin based adjuvant chemotherapy for molecular high and intermediate risk patients. lower bound assumptions for relative improvement, cost of care, and compliance yielded persistent savings of 3699\$, 8091\$ and 8486\$, respectively.

utilization of this predictive molecular risk stratification assay in the management of stage I-III non-squamous NSCLC has the potential to significantly reduce lung cancer costs in an era of targeted therapy and immunotherapy, while at the same time improving DFS and saving lives

cost effectiveness of combination ipilimumab nivolumab in advanced non small cell lung cancer abstract e19387

the combination of nivolumab and ipilimumab was found to improve overall survival compared to chemotherapy in patients with advanced non small cell lung cancer [NSCLC] in the checkmate 227 trial. however, nivolumab and ipilimumab are significantly more expensive than chemotherapy, and given the high incidence of advanced lung cancer, incorporating dual checkpoint inhibitors into the standard of care could have substantial economic consequences. in this study, the cost effectiveness of combination ipilimumab and nivolumab for the treatment of advanced NSCLC was evaluated.

a markov model was designed simulating the three treatment arms of the Checkmate 227 trial- nivolumab plus ipilimumab, nivolumab monotherapy, and chemotherapy. Transition probabilities, such as disease progression, survival, and treatment toxicities, were derived from trial data. costs [in 2019 USD] and health utilities were estimated from published literature. incremental cost effectiveness ratios [ICERs], expressed as dollar per quality adjusted life year [QALY], were calculated, with results less than 100.000\$/QALY considered cost effective from a healthcare payer perspective.

in this base case model, nivolumab and ipilimumab combination therapy increased overall cost by 227.700\$ and improved effectiveness by 0.55 QALY compared to chemotherapy, resulting in an ICER of 413.400\$/QALY. nivolumab monotherapy increased overall cost by 98.500\$ and improved effectiveness by 0.05 QALY compared to chemotherapy, resulting in an ICER of 1.885.400\$/QALY. the model was most sensitive to both the cost and duration of dual immunotherapy. combination immunotherapy became cost effective at an ICER under 100.000\$/QALY if monthly costs of treatment were reduced from 26.586\$ to 8844% [a 67% reduction] or if maximum allowed duration of immunotherapy was reduced from 24 to 4 months. the model was not sensitive to assumptions about survival differences between the study arms. probabilistic sensitivity analysis showed that at a willingness to pay threshold of 100.000\$/QALY, dual immunotherapy was less cost effective than chemotherapy 99.99% of the time.

combination nivolumab and ipilimumab immunotherapy is not cost effective at current prices despite increasing overall survival for patients with advanced NSCLC.

cost effectiveness of genomic profiling in veterans with metastatic lung adenocarcinoma abstract 7075

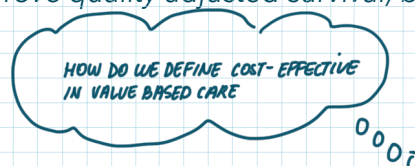
tumour profiling identifies patients who are eligible for targeted anti cancer therapies. common tumour profiling approaches include targeted gene panel testing [TGPT], which tests for common mutations in select genes, and multigene panel sequencing [MGPS], which tests for a broad range of mutations in a comprehensive set of genes. the objective was to determine the lifetime cost effectiveness of MGPS and TGPT compared to no tumour profiling for veterans with metastatic lung adenocarcinoma from the veterans health administration's [VHA] perspective.

a decision analytic model was developed to simulate outcomes for a closed cohort of hypothetical veterans with metastatic lung adenocarcinoma considering anti cancer therapy. oncoKB genes with levels of evidence 1 and 2 for guiding therapy were included. three profiling strategies were studied: TGPT [ALK, EGFR, ROS1], MGPS [ALK, BRAF, EGFR, HER2, MET, NTRK1, NTRK2, NTRK3, RET, ROS1], and no tumour profiling. assuming 95% of patients with actionable mutations received targeted therapies. non targeted therapy options included chemotherapy and/or immunotherapy, and no anti cancer therapy.

base case results indicated the cost/QALY gained was 309.399\$ [280.371\$-343.161\$] for TGPT and 324.707\$ [296.086\$-359.778\$] for MGPS compared to no tumour profiling. of the three strategies, MGPS resulted in the highest number of QALYs. the cost of targeted therapies and non drug cancer related management were the key drivers of this high cost per QALY. one way sensitivity analyses revealed the cost/QALY estimates were most impacted by changes in health state utility on a targeted therapy [quality of life], costs of alectinib, and non drug cancer related costs in patients receiving targeted therapy. compared to no tumour profiling, cost effectiveness ratios for both profiling approaches surpassed the 150.000\$/QALY threshold in 100% of probabilistic sensitivity analyses [PSA] simulations. at a higher WTP thresholds [>310.000\$] tumour profiling strategies were more likely to be cost effective.

Tumor Profiling Strategy	Cost per patient	QALYs per patient	Incremental cost per QALY gained
No molecular profiling	\$114,858	0.53	--
TGPT	\$174,010	0.72	\$310,566
MGPS	\$183,440	0.74	\$448,737

tumour profiling [TGPT or MGPS] can optimize anti cancer therapy selection in patients with metastatic lung adenocarcinoma and improve quality adjusted survival, but compared to no tumour profiling, is not cost effective.



pivotal trial endpoints and prices of cancer drugs in the US and europe abstract 2077

the amount of approved cancer drugs as well as their launch prices have increased in the US and europe. a key clinical outcome for new cancer drugs is improvement in overall survival [OS], defined as the time from the start of the treatment to death. however, many cancer drugs are approved by regulators based on changes to surrogate measures of OS, such as progression free survival [PFS] or overall response rate [ORR]. when surrogate measures are not validated, they can provide misleading information about drug efficacy. pivotal trial endpoints for recently approved cancer drugs in the US and Europe were categorized as showing improvements in OS vs non OS surrogates, and evaluate the correlation to determine if an association exists between the most clinically valuable endpoint [OS] and their drug prices

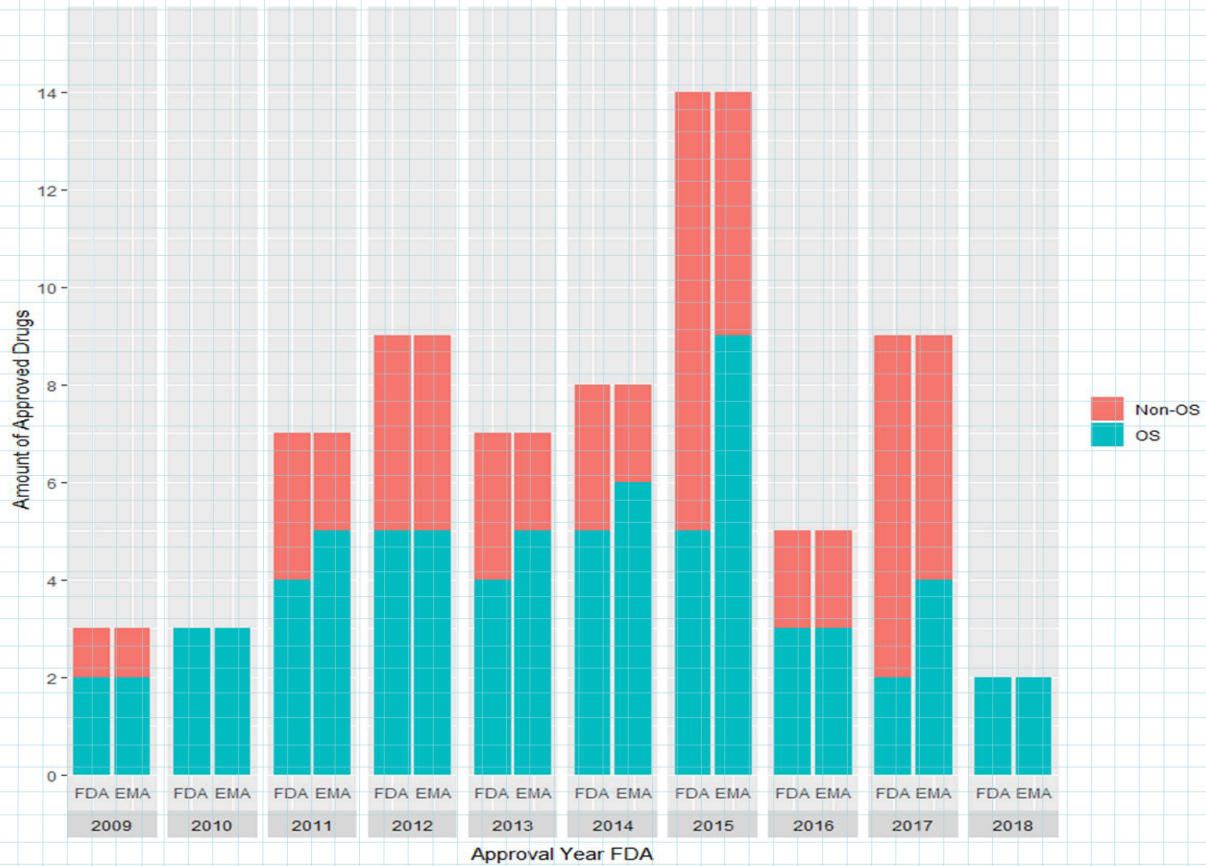
new drugs approved by the FDA between 2009 and 2018 indicated to treat solid and hematologic tumours in adults and that had also been approved by the EMA and swissmedic [by december 2019] were identified. launch prices were extracted and adjusted to average sales prices for monthly treatment costs in the US and compared to currency adjusted ex-factory monthly treatment costs in germany, switzerland, and england.

the study cohort included 67 drugs approved by the FDA and EMA for solid and hematologic tumours during the study period that had a price listed in at least one of the assessed countries [US, england, and germany]. in the US, 35 [52%] of the drugs are approved based on OS, in contrast 44 [66%] were approved by the EU.

crizotinib [xalkori], ceritinib [zykadia], osimertinib [tagrisso], and alectinib [alecensa], are all drugs indicated for NSCLC, were FDA approved based on pivotal trials with surrogate measures used as a primary endpoint, while the pivotal trials viewed by EMA used OS. the trends of commonly approve drugs within the FDA and the EMA based on OS and non-OS endpoints are illustrated in figure one, where a decrease in FDA drug approval based on OS is also observed in the last years of the cohort. one reason for these trends would be the difference in timing of submissions, since new drug applications tend to be submitted for the FDA. the EMA may therefore have access to more mature data from the same clinical trial. another reason could be that the FDA has a higher level of tolerance for less rigorous data to promote access to new cancer drugs. *the FDA and EMA have strengthened their dialogue and exchanged information more frequently in recent years and these differences may lessen in the future.*

the FDA approved more recent cancer drugs based on surrogate measures compared to the EMA. no associations were found between monthly treatment costs and the pivotal trial endpoints [OS vs surrogate measures] in the US or europe. due to limited resources, drug pricing should be better aligned with the benefit that drugs provide to patients, as measured by clinical trial outcomes. reductions in use of OS endpoints as the basis for cancer drug approval in the US is concerning.

Amount of Drugs with OS and Non-OS as Pivotal Trial Outcomes Based on US Approval Year



launch prices and price developments of cancer drugs in the united states and europe abstract 2006

cancer drug costs are rising in the US and europe. while drug manufacturers set prices without restriction in the US, european countries have regulations that allow national authorities to directly negotiate drug prices at launch and over time. launch prices and price developments of cancer drugs in the US, germany, switzerland and england were analyzed and compared in this study.

initial prices of cancer drugs have risen more than 100 fold since 1965 in the US and cancer medicines account for 25% of total health expenditures on cancer in the EU.

new drugs indicated to treat solid tumours in adults that were FDA approved between 2009 and 2019 and had also been approved by the EMA and swissmedic by 31 december 2019. launch prices and post launch price changes as of 1 january 2020 were extracted and adjusted to average sales prices for monthly treatment costs in the US and compared to comparable currency adjusted ex-factory monthly treatment costs in germany, switzerland, and england. a cross-sectional analysis was conducted to infer yearly trends in launch prices and post-launch price changes across the countries.

the study cohort included 42 drugs for solid tumours, of which 40 [95%] drugs were first approved in the US compared to germany and england, and 41 [98%] to switzerland. average launch prices for monthly treatment costs per patient were 15.178\$ in the US vs 7049\$ in Germany, 7421\$ in Switzerland and 8176\$ in england, i.e., 215% and 186% higher in the US compared to germany, switzerland and england respectively. post launch prices of 36 [86%], 40 [95%], and 38 [90%] drugs decreased over time with total savings of monthly treatment costs for all drugs in the study cohort of 86.744\$, 44.936\$, and 1744\$ in germany, switzerland, and england respectively. by contrast, prices of 8 [19%] drugs decreased, while 34 [81%] increased post launch in the US with total additional expenses of 128.192\$ for monthly treatment costs.

launch prices for cancer drugs are far higher in the US than in germany, switzerland, or england. these price disparities continue to increase substantially after market entry since cancer drug prices, in general, decrease over time in europe and increase in the US. spending on cancer drugs could be reduced in the US if it adopted the principles used to more effectively negotiate drug prices in europe.

patient preferences and expectations of systemic therapy in renal cell carcinoma abstract 5083

in metastatic renal cell carcinoma, the systemic therapy landscape has expanded to include multiple VEGF inhibitors, immunotherapies, and combination therapy. little is known about patient expectations and preferences when making decisions about systemic therapy. researchers sought to gather independent data from online kidney cancer patient communities to assess patient perspectives on what matters most when considering treatment options

the KCCure online survey was performed between august 1, and september 30, 2019. patients were recruited via the KCCure website, social media channels [twitter, facebook] and through fliers distributed at cancer centres. those who agreed to participate were surveyed for demographics [age, gender, race, income, country] and clinical characteristics [date of the diagnosis, disease stage, treatment history]. key questions focused on treatment selection and side effect management.

of 1,136 patients responding, 411 patients were on systemic therapy with a median age of 57 years [range 28-86]. 223 [54%] of patients on systemic therapy were male. patients were primarily from the U.S. [83%]. median duration on therapy was 24.7 +/- 1.9 months. when asked to select the most important outcome for treatment selection, 58.8 % of patients chose complete response, followed by tumour control [10.2%], low risk of toxicity [5.7%] and the possibility to discontinue therapy [3.7%]. patients ranked cost as the least important factor in selecting treatment [2.9%]. 10.9% preferred infusion therapy and 42.1% oral therapy, whereas 47% were indifferent about the route of administration. even if it would be safe to discontinue therapy, 62.8% of patients would be anxious about cancer progression. 23.2% would rather stay on treatment and 39.3% would want increased scanning intervals. only 34.4% of patients would look forward to having more time off therapy. when asked to define treatment success, 86.3% selected reduction in tumour size, followed by stable disease [71.7%], freedom from symptoms [35.1%] and better quality of life [47.7%].

patients rank efficacy as the most important outcome when considering treatment options. toxicity, time off therapy and cost are not significant priorities for patients. further data is warranted in investigating the impact of communicating treatment options, potential discontinuation of therapy and resulting expectations.

total cost of lung cancer care associated with broad panel versus narrow panel sequencing abstract 7077

many lung cancer patients are diagnosed late with advanced or metastatic disease. targeted therapies can improve quality of life and increase the chances of progression free survival versus conventional treatments. an understanding that there may be more than one driver mutation associated with a specific lung tumour is crucial for the timing and delivery of the most effective line of therapy. broad panel sequencing [BPS] minimizes tissue use and enables personalized treatment that decreases the use of ineffective agents and unwarranted side effects, in addition to opening pathways to early clinical trials. however, many payors do not reimburse for BPS. the objective of this study was to determine if BPS leads to lower total cost of care versus narrow panel sequencing [NPS].

new lung cancer patients who completed BPS [current procedural terminology [CPT] code 81455, 51+ genomic test] or NPS [CPT code 81445, 5-50 genomic test] using medical claims from january 1, 2018, to march 31, 2019 were identified. total cost of care was defined as allowed costs paid for medical and pharmacy claims across a six month time period from the first gene sequencing panel. the allowed costs of BPS and NPS were also compared.

45 patients who underwent BPS sequencing and 399 patients who underwent NPS were identified. with an average BPS cost of 1977\$ +/- 2713\$ versus the average NPS lab cost 719\$

+/- 1087\$. the average six month per member per month [PMPM] total cost was 11.535\$ +/- 9168\$ among those who underwent BPS compared to 20.039\$ +/-19.642\$ in those who underwent NPS. this difference of 8504\$ was statistically significant.

BPS has been shown to optimize treatments in patients with lung cancer. these initial results of claims suggest that while lung cancer patients undergoing BPS have higher total-sequencing costs than those undergoing NPS, *BPS significantly reduces overall total cost of lung cancer care. identifying the broader genomic landscape of a patient's tumour earlier will empower oncology providers and lung cancer patients with information to make timely, precise treatment decisions that are ultimately more cost effective.*

the correlation between clinical benefit and financial cost of cancer drugs abstract 7071

the cost of many cancer drugs is very high, but it is unclear if these costs are associated with commensurate improvement in outcomes. This study aimed to assess the association between the cost of cancer treatments and their clinical benefit, using the NCCN evidence blocks value assessment framework. the cost of cancer treatment has risen significantly in recent decades, but it is unclear if these costs have been associated with commensurate improvement in clinical value. if prices are not justified by clinical value, there is a need to re-examine current drug pricing models.

the NCCN evidence blocks include four measures of clinical benefit: efficacy, safety, quality of evidence, and consistency of evidence. these scores are based on evidence as well as expert opinion where evidence is lacking. the NCCN assigns scores on each measure ranging from 1 [least favourable] to 5 [most favourable]. the NCCN evidence blocks scores as of december 31, 2018 were obtained for all recommended cancer treatments for the 30 most prevalent cancers in the US. for each treatment, total treatment costs [including drugs, administration fees, and supportive care medications] were calculated using medicare reimbursement rates and were categorized treatments as either "time-limited" or "time-unlimited" according to whether their costs are best reflected as per full treatment course [adjuvant/neoadjuvant treatments] [time-limited] or per month of therapy [treatments for advanced disease] [time-unlimited]. generalized estimating equations, with clustering within treatment indications were used to estimate the association between evidence blocks scores and treatment costs. price calculations included supportive care drugs, but not indirect costs, such as hospitalizations or time loss from work. in these models, the cost of the regimen was treated as the outcome, and each of the four measures--efficacy, safety, quality, and consistency-- were the predictors.

there were 541 time unlimited and 845 time limited treatments. among time unlimited treatments, monthly treatment cost ranged from 4\$ to 64.630\$. monthly treatment cost was positively associated with efficacy [3036\$: 1782\$, 4289\$] and quality of evidence [1509\$, 171\$,

2847\$] but negatively associated with safety [-1470\$: -2790\$, -151\$] and consistency of evidence [-2003\$ -3420\$, -586\$]. among time limited treatments, cost per course of therapy ranged from 0\$ to 775.559\$, and no measure was significantly associated with cost. evidence blocks scores accounted for little of the variation in treatment cost. an increase in one point on efficacy was correlated with an increase in cost of 3036\$, but a better safety score, with a decrease in 1470\$. this would imply that all other things being equal, including efficacy, a regimen that had more toxicity would get rewarded with higher price and the degree of clinical benefit accounts for little if any of the prices of cancer drugs.

these results would support serious changes to our current drug pricing model, which does not appear to reward better treatments with better prices. possible solution to the status quo might involve value based pricing, direct regulation of drug prices, and/or a higher regulatory bar for approval in order to keep from coming to market, all the drugs which will continue to command higher prices, but without making significant advances in clinical value.

the association between NCCN evidence blocks measures and treatment cost was inconsistent, and accounted for little of the cost variation among treatments for the same indication. the *clinical benefit of cancer treatments does not appear to be a primary determinant of treatment cost, suggesting that current pricing models may be inadequate to incentivize the development and utilization of high value treatments.*

resource and reimbursement barriers to comprehensive cancer care [CCC] delivery. an association of community cancer centres [ACCC] survey research analysis abstract 2075

CCC delivery is recommended in guidelines, required by accreditation bodies, and essential for high quality cancer management. barriers, such as insufficient reimbursement and lack of specialist staff, prevent consistent access to and delivery of CCC, particularly supportive oncology services. challenges especially persist in community programs, where access to philanthropy and similar funding is limited. ACCC conducted a representative survey of its member programs to elucidate capacity and barriers to CCC delivery in the community/academic setting in order to inform policy and value based payment reform.

an online survey was piloted at the ACCC 2018 annual meeting and sent to member programs via email link. the final survey included 22 questions on availability and funding for supportive services. 27 supportive oncology services were assessed for availability, reasons not offered, reimbursement/funding and patient payment.

172 of 704 ACCC member programs responded and completed the majority of the survey. despite a high proportion of programs offering supportive oncology services, gaps between cost and reimbursement were present for all. deficits in reimbursement are compensated by patient out of pocket payments, grants and donations. most centres report needing more staffing in psychology [61%], social work [60%], navigation [59%], nutrition [57%], palliative care [56%], genetic counselling [52%], and financial counselling [53%].

survey responses demonstrated that programs are not getting reimbursed adequately and in some cases, can't offer services. oncology care models and reimbursement policies must include *CCC services to optimize delivery of care*. there is a need to estimate the costs of providing these essential services that are currently available and should be utilized routinely by centres but also to calculate the costs for the services not currently reimbursed to develop uniform strategies for payment reform. cancer centres will need to generate data to inform their true personal requirements and costs of such with development of external partnerships to systematically link patients with services they cannot provide as a component of their comprehensive cancer plan for each patient.

driving quality improvement. how clinical decision support can facilitate compliance with evidence based pathways abstract 2045

cancer care is changing rapidly -as cancer types become more specific and treatment options continue to grow in number, combination, and sequence, compliance with evidence based treatment guidelines is more challenging, with more detailed understanding of disease and numerous therapeutic choices. as treatment choice is more complex, mechanisms to improve compliance with evidence based treatment can improve the quality of cancer care. as a network, a process for incorporating value based guidelines in clinical practice by having expert driven, transparent, evidence based, up to date, comprehensive, iterative clinical pathways with stakeholder input was developed. these evidence based pathways [EBP] are implemented broadly.

a clinical decision support system to facilitate compliance with evidence and value based guidelines was developed and embedded within the electronic health record [EHR] at the point of care and sought to understand how it would impact data, compliance overall, compliance to a preset benchmark of 75% and exception reporting.

a retrospective cohort study was conducted from january 2014- may 2016 evaluating the impact of a clinical decision support system [CDSS] on compliance with evidence based pathways [EBP] across nine statewide community based oncology practices [633 physicians prescribing over 30.000 individual patient retreatment regimens over a six month period]. these EBP are developed with physician input on efficacy toxicity and value and incorporated into a CDSS that

is used within the EHR at point of care to alter the choice architecture a clinician sees when prescribing therapy.

regimen compliance with EBP was measured pre and post implementation of the CDSS tool across a large network. the CDSS that is incorporated within the EHR significantly improved compliance with EBP across the entire cohort of practices, and in individual practices. individual oncologists reached a target of 75% compliance more often [58% vs 72%] after implementation of the tool.

CDSS is a tool that improves compliance with EBP that is effective at improving targets of compliance broadly, at the practice, and at the individual clinician level. clinical informatics solutions that influence physician behaviour can be inclusive of physicians in design, iterative in process, and nudge as opposed to force clinician behaviour to drive quality improvement. these clinical informatics solutions grow in importance as the complexity of cancer care continues to increase and we seek to improve upon the quality and value of care delivery. there is a lot of information out there today about how it's important to have learning health care systems. understanding variance from guideline based behaviour is an important way to continue to improve the process.

factors associated with change in the magnitude of clinical benefit of anti cancer drugs in the post marketing period abstract 7052

initial drug approval is often based on surrogate endpoints and definitive outcomes like overall survival [OS] or quality of life [QoL] may not be available. this study evaluates changes in the magnitude of clinical benefit using the american society of clinical oncology value framework [ASCO-VF] and european society for medical oncology magnitude of clinical benefit scale [ESMO-MCBS] comparing the time of approval to the most recent available data for cancer drugs approved by the US food and drug administration [FDA] between 2006 and 2015.

data on trials supporting FDA accelerated [AA] and regular [RA] cancer drug approvals between january 2006 and december 2015 were examined. a systematic search of pubmed and clinicaltrials.gov was performed to identify updated OS and/or QoL data, with follow up through april 2019. for AA drugs initial and confirmatory trials were analysed as follow-up. ASCO-VF and ESMO-MCBS grades were applied for trials at approval and after marketing.

102 trials were identified supporting the approval of 59 drugs for 96 solid tumour indications. 22 [23%] were granted AA and 21 [95%] were converted to RA. at time of approval, 38% of trials showed improved OS and 17% improved QoL. substantial clinical benefit was observed in 26% of initial approval trials using ESMO-MCSB and in 34% using ASCO-VF. after a median post marketing period of 3.3 years, updated results changed substantial clinical benefit in 20 trials

with ESMO-MCBS [19 upgrades, 1 downgrade] and in 23 trials using ASCO-VF [19 upgrades, 4 downgrades]. For 25% of trials no updated information was found. in the palliative setting, multivariable analysis showed association between improved ASCO-VF scores and initial approvals based on single-arm trials [OR 9.21], drugs with companion diagnostics [OR 4.95] and second or later lines [OR 7.80] while for ESMO-MCBS, drugs with companion diagnostics [OR 6.86] and immunotherapy drugs [OR 6.42] were associated with greater clinical benefit.

drugs with companion diagnostic tests, immunotherapy as well as approved based on single-arm trials were associated with increased clinical benefit between registration and post marketing.

assessing the potential cost effectiveness of the addition of atezolizumab to first line platinum chemotherapy in advanced urothelial cancer. implications for value based pricing abstract 5031

data from interim analysis of IMvigor130 trial showed that 1st line treatment of advanced urothelial cancer [aUC] with atezolizumab + platinum based chemotherapy [PBC] significantly improved progression free survival [PFS], but not overall survival [OS], vs PBC. switch maintenance anti PD[L]1 after completion of PBC as 1st line therapy is an alternate strategy, recently reported to significantly prolong OS. the aim was to compare cost effectiveness of combined treatment [atezo+PBC] vs PBC based on IMvigor130.

a partitioned survival model was used to evaluate the potential cost effectiveness of treatment with a. atezo+PBC [gemcitabine with cisplatin or carboplatin] or b. PBC alone with checkpoint inhibitor pembrolizumab at progression [standard of care]. PFS and OS curves were extracted from IMvigor 130 and parametric models were fit to approximate outcomes with atezo+PBC with the hazard ratio [HR] from the trial used to project outcomes for PBC alone. a health care payor perspective was used with a two year time horizon. model outputs – costs, life years, quality adjusted life years [QALYs] – were used to calculate an incremental cost-effectiveness ratio [ICER]. a scenario analysis evaluated the “value based price” needed for atezo+PBC to be cost effective; a one-way sensitivity analysis was also performed.

the mean projected incremental cost of atezo+PBC compared to PBC was 59.604\$ for a mean incremental gain of 0.09 life years and 0.07 QALYs. this resulted in an ICER of 629.755\$/life year and 895.800\$/QALY, respectively. a 33% reduction would be needed in the price of atezolizumab to make atezo+PBC cost effective at an ICER of 150.000\$/QALY. results were sensitive to cost of pembrolizumab at progression, the cost of atezo+PBC, and the OS HR between atezo+PBC and PBC.

combined chemoimmunotherapy with atezolizumab and PBC would likely not be cost effective for the first line treatment of aUC. however, with a price rebate of 33%, it would approach being cost effective at a widely used cost effectiveness threshold – the ICER would be projected to be 105.455\$ per life year and 150.000\$ per quality adjusted life year. a one way sensitivity analysis, showed the results of the model were sensitive to the cost of pembrolizumab at progression, the cost of atezolizumab with platinum chemotherapy and the overall survival hazard ratio of atezolizumab with chemotherapy. none of the ranges inputted into this analysis yielded a result that crossed the 150.000\$ willingness to pay threshold

perioperative circulating tumor DNA [ctDNA] analysis to predict patient prognosis in liver cancer abstract 4593

resection is a major method for early stage liver cancer patients - unfortunately, there are still patients with post operation recurrences. circulating tumour DNA [ctDNA] has been reported as a biomarker in reflecting tumour load and treatment efficacy in some cancer species. Researchers report an application of ctDNA in the perioperative period of liver cancer using targeted sequencing with a 1021-gene panel. this study aims to assess the possibility of ctDNA single or combined with baseline alpha fetoprotein [AFP] to predict the recurrence postoperative.

97 patients diagnosed with liver cancer were enrolled in this study. postoperative peripheral blood samples were collected within seven days after surgery and analyzed using hybridization capture based NGS ERSeq method from all patients. whether a mutant gene was detected in the peripheral blood was defined as ctDNA[+] and ctDNA[-], respectively.

the post operation ctDNA was an independent poor prognostic predictor. 21 patients were ctDNA[+], and all of them had recurrence [21/21, 100%], while 76 patients were ctDNA[-], and only 12 [12/76, 15.8%] patients had recurrence. the median disease free survival [DFS] time was 5.0 months in ctDNA[+] group and the ctDNA[-] group had not reach the median time. ctDNA combined with AFP would effectively predict the prognosis of patients after surgery. AFP[H] and ctDNA[+] patients have the worst prognosis and all of the patients had relapsed, while AFP[L] and ctDNA[-] patients had the best prognosis, with less than 20% of patients relapsed. the median DFS time was 2.0, 6.0 and 7.0 months in ctDNA[+]-AFP[H] [n = 8], ctDNA[-]-AFP[H] [n = 30] and ctDNA[+]-AFP[L] [n = 13] groups, respectively, while ctDNA[-]-AFP[L] group [n = 46] had not reach the median time statistically.

in summary, *perioperative ctDNA detection has great potential value clinically, and it also suggests that patients with positive ctDNA after surgery should receive some adjuvant treatments as soon as possible to improve the survival time.*

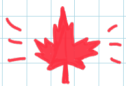
costs of extended immune check point inhibitors treatment in advanced | metastatic lung cancer. bundling of costs proposal abstract e21738

pembrolizumab demonstrated remarkable five year overall survival [OS] and hazard ratios [HR] in 1st-line advanced | metastatic lung cancer [amLC] lacking EGFR and ALK alterations. after 35 cycles or two years, there is no consensus on whether to continue or stop the immune check point inhibitors [ICI]. In contrast to ICI receiving no cost adjustment, CAR T cell were contained at 375.000-400.000\$. probability of survival [PoS] was previously expressed as [1.0- HR] and used as surrogates of outcome. the objective was to weigh ICI costs at one year and beyond vs PoS.

costs of durvalumab 10mg/Kg iv were calculated in USD q2 weeks. pemetrexed 500 mg/m², atezolizumab 1200 mg and pembro 200 mg were computed q3 weeks. HR at the 95% confidence levels were quoted and PoS calculated.

the average ICI yearly costs were 153.053\$, increasing annually by 2-4%. peme were 108.108\$ and PoS 0.22. one year adjuvant durv in unresectable stage III were 145.808\$ at PoS 0.47. pembro were 157.213\$ and PoS 0.40 in PD-L1 > 50%. pembro costs beyond five years exceeded 786.065\$. pembro- peme-carboplatin in non squamous histology were 265.321\$. PoS was 0.41 in PD-L1 < 1% and 0.58 in > 50%. atezo+bev 4-drug-costs were higher at 389.134\$ with modest 0.22 PoS. setting monotherapy ICI yearly costs at 160.000\$, one patient treated for three years would pay 480.000\$. bundling costs at 400.000-450.000\$ would save 30.000-80.000\$. savings would multiply with further years of extension.

at 0.47 PoS, the one year cost of adjuvant durv was worth the dollars spent. the runaway ICI costs beyond two years would support the cost bundling proposal.



impact of value frameworks on the magnitude of clinical benefit. evaluating a decade of randomized trials for systemic therapy in solid malignancies abstract e19410

in the era of rapid development of new, expensive cancer therapies, value frameworks were developed to quantify clinical benefit. the evolution of the magnitude of clinical benefit was assessed since the 2015 introduction of the ASCO and ESMO value frameworks.

randomized phase II and III clinical trials assessing systemic therapies for solid malignancies from january 2010 to july 2019 were evaluated. study characteristics were recorded, and magnitude of clinical benefit (Δ) was calculated for the endpoints overall survival [OS], progression free survival [PFS], response rate [RR], and quality of life [QoL]. Multivariable analyses compared Δ OS, Δ PFS, and Δ RR in 2010-2014 [pre value frameworks [PRE]] to 2015-2019 [post value frameworks [POST]].

in the 290 studies analyzed [60 [21%] PRE and 230 [79%] POST], the most common primary endpoint was PFS [46%], followed by OS [20%], RR [16%], and QoL [8%], with a non significant increase in OS and decrease in RR as a primary endpoint in the POST era. studies evaluating immunotherapy and palliative therapy significantly increased POST [0 [0%] v 39 [17%]. studies reporting improvement in QoL doubled POST [3 [5%] v 22 [10%]], however not statistically significant. median Δ OS was significantly greater POST but there was no significant difference in median Δ PFS or Δ RR. Multivariable analyses revealed significant improvement in Δ OS POST [OR 3.08] while adjusting for drug mechanism of action, line of therapy, disease setting, and primary endpoint.

after the development of value frameworks, median OS improved minimally. the impact of value frameworks has yet to be fully realized in randomized clinical trials. efforts to include endpoints shown to impact value, such as QoL, into clinical trials are warranted.

Study characteristics pre- and post-publication of value frameworks.

		No. of studies PRE* (%)	No. of studies POST* (%)	P-value (^a Fisher's exact)
Primary endpoint	OS	9 (15)	0.07 ^a	
	PFS	27 (45)	107 (47)	
	RR	16 (27)	28 (12)	
	QoL	2 (3)	19 (8)	
	Other	6 (10)	26 (11)	
Experimental drug class	Cytotoxic	21 (35)	68 (30)	<0.01 ^a
	Targeted/antibody	36 (60)	113 (49)	
	Immunotherapy	0	39 (17)	
	Other	3 (5)	10 (4)	

*If a trial had >1 experimental arm, each arm was counted as a separate study.

cost savings of biosimilar pegfilgrastim in a medicare OCM population abstract e19362

pegfilgrastim is a key supportive care agent in oncology patients, providing significant febrile neutropenia prophylaxis for patients on chemotherapy. pegfilgrastim also accounts for 5.3% of the total cost of cancer care for all patients in the oncology care model [OCM]. fluctuations in the cost or quantity of pegfilgrastim can have significant impact on a practice's performance under OCM. one such cost fluctuation is the introduction of biosimilars to the marketplace. this study seeks to understand how CMS reimbursement for pegfilgrastim has been impacted by the introduction of two pegfilgrastim biosimilars into the market.

average CMS reimbursement for pegfilgrastim was tracked [neulasta, udenyca and fulphila] from 07.01.2016 through 06.30.2019. and the average reimbursement and the average change in reimbursement before and after the introduction of biosimilars was compared.

prior to the introduction of biosimilars, the medicare part B reimbursement of pegfilgrastim increased at a steady rate of 292\$ per year through the first 30 months of the OCM program, resulting in an average reimbursement of 3636\$ per administration in Q3 2018. since the introduction of biosimilars, average pegfilgrastim reimbursement has held steady, averaging 3543\$ for the time period from 07.01.2018 through 06.30.2019. the change in reimbursement has decreased from 292\$/year to -93\$/year.

in 2018, 88.847 medicare patients received pegfilgrastim, resulting in 1.39\$ billion in medicare reimbursement. assuming the patterns detected in the OCM data sample can be applied to the general medicare population, *it is estimated that the introduction of biosimilars resulted in a 4.8\$ million in savings [1.39%] compared with what the total reimbursement would have been without biosimilars in the market in Q4 2018. this bending of the cost curve is projected to result in savings of 79.1\$M [5.7%] in 2019 and 157.9\$M [11.5%] in 2020.* importantly, most of this cost containment is not due to patients utilizing biosimilars. 90.6% of patients in Q2 2019 are still receiving branded pegfilgrastim. however, the introduction of biosimilars has caused even the branded agent to stabilize and possibly even drop net acquisition cost prices.

introduction of biosimilars has created enough pressure on the market to result in significant cost savings, increasing the overall value proposition of pegfilgrastim - resulting in significant cost saving to CMS, and also makes it easier for practices participating in OCM to have successful financial outcomes.

establishing the six-month resource utilization and cost of care for the treatment of first line metastatic BRAF [V600] melanoma with combination BRAF and MEK inhibitors abstract e19396

comparative data on cancer therapy health care resource utilization (HCRU) and associated cost will be helpful as value based healthcare moves forward. BRAF and MEK inhibitor combinations are considered first line treatment for BRAF [V-600] metastatic melanoma [MM], although head to head trials are lacking. this study aimed to establish the real world HCRU and six month cost of care in V-600 MM treated with BRAF and MEK inhibitor therapy.

a single data team in 2018 performed a multicentre, retrospective chart audit of adult patients with BRAF V-600 MM. four institutions from across the US with patients who had received either dabrafenib + trametinib [DT] or vemurafenib + cobimetinib [VC] were enrolled. in the most recent 12mo period, data was captured from the start of therapy for six months or until therapy was stopped. dose change or stoppage was accessed for cause [toxicity, disease, death, other]. variables included hospitalization, emergency room [ER], all clinic visits [routine + extra], scans, labs, and treatment drug [AWP]. medicare reimbursed rates were applied for cost estimates. utilization and costs were measured on per patient per month [PPPM] bases and the total cost over six months for each combination.

of the 42 patients included, 34 and 8 were initiated on DT and VC, respectively. proportions of patients with extra clinic visits and hospital admissions were 79%, 15% and 75%, 13%, respectively for DT and VC. PPPM hospitalization was the lowest among the resources utilized 0.24 for DT and 0.17 for VC. a higher proportion of VC patients [75%] had a dose reduction due to drug toxicity compared with 29% of patients treated with DT. discontinuation rates were the same between both combinations. 32 patients had completed six months of treatment [26 DT and 6 VC]. for those DT, the mean total costs including drug and the mean monthly total costs were 157.253\$ and 26.209\$ compared to 107.240\$ and 17.873\$ for VC, respectively. the mean total costs for hospitalization were 10.562\$ for DT and 7456\$ for VC. the mean total costs for the drug were 145.012\$ for DT and 97.924\$ for VC.

the six month total cost of care for the treatment of first line V-600 MM with DT was 157.253\$ and 107.240\$ for VC, mostly attributable to drug cost. in a value based healthcare system, total six month cost of care may help distinguish between equally effective regimens.

US oncologists' perception of the efficacy, safety, and willingness to prescribe biosimilar cancer therapies abstract e15213

biosimilars are the fastest growing class of therapeutic products in the united states and can offer treatment options that can potentially lower healthcare related costs in cancer care. it is essential to understand an oncologist's willingness to use biosimilars. the expected biosimilar prescribing behaviours of practicing oncologists were assessed for the originator products avastin, herceptin, rituxan and neulasta.

an online cross sectional survey of 75 hospital affiliated [46.7%] and community based [53.3%] oncologists was performed in july 2019 using a likert scale rating of 'never', 'seldom', 'sometimes', 'often' and 'always'. descriptive statistics and percentages are reported.

the majority of oncologists [62.7%] worked in a for profit practice, with 38.7% of primary practices offering exclusive in office dispensing. physicians currently reported prescribing branded drugs often or always 76% of the time. when asked to rate biosimilars by quality, safety and effectiveness, over 70% of providers perceived these four biosimilars to be the same or near equivalent to the branded drug. when asked to report their expected likelihood of prescribing a biosimilar in the future, 60% of providers believed they would often or always prescribe a biosimilar. there was no difference in the providers' current biosimilar prescription pattern by type of insurance plan. provided financial equivalence, oncologists reported being more likely to prescribe a biosimilar to new patients [85.3%] compared to existing patients [69.3%]. the top 3 drivers of using biosimilar cancer therapies are the patient's out of pocket cost, value of reimbursement and cost to the practice; 61%, 51% and 52%, respectively for fee for service reimbursement and 69%, 44% and 61%, respectively for value based reimbursement.

biosimilars are expected to reduce drug expenditures in cancer care. while providers in this study found biosimilars to be safe and effective, they reported being less likely to prescribe these drugs when there is a potential for their practice to lose money and control of the drug. payment models for biosimilars in cancer care must support practice economics.

optimizing cancer care using digital technologies requires coordinated multi stakeholder effort abstract e14108

oncology has unique characteristics that predict early benefit from digital technologies including a culture of patient involvement in trials, genetic testing, and longitudinal assessments including objective measures. implementation of digital tools is slow for many reasons including lack of incentives | interoperability, and high profile cases highlighting inadequate data governance. results from the digital medicine society's study of the stakeholders involved in using digital technologies to optimize health, with a focus on oncology is reported.

16 interviews with diverse key opinion leaders [KOLs] including physicians, executives, senior government officials, patients, payors, tech innovators, and investors were conducted. KOLs received a pre interview list of topics. using the delphi method, an evidence based approach to compile expert opinions, to iteratively refine recommendations.

priorities for five stakeholder groups were identified to facilitate digital tool implementation [table]; all groups must also develop a framework for data governance. four categories of early success in oncologic digital tools are described: regimen | drug choice, drug approval efficiency, digital user training, and patient generated health data.

data and technology have great potential to improve cancer care. multi stakeholder involvement and a framework for US health data governance are needed.

Healthcare Systems	Tech Industry	Patients	Life Sciences	Government
Have a digital strategy and invest	Ensure a clinical perspective on your team to understand workflows/culture	Patient demands don't have to be digital	Establish new partnerships and collaborations to support use of data and technology	Embrace collaboration with the private sector (and patients)
Recognize the potential of using data to manage risk	Design products/ systems to address unmet needs	Make sure tech tools are trustworthy	Data sharing remains critical , but is just the first rung on the ladder	Drive more towards value-based care reimbursement models, like the Oncology Care Model
Free the data! While protecting patient autonomy and privacy	Fast is good. Right is better.	Patient data sharing preferences should be honored	Bridge the divide between clinical trials and clinical care	Fund evaluation and enforcement of digital rules and policies.
Embrace patient-generated health data	Actively strive to protect against unintended consequences of data "solutions"			Monitor the market and rapidly react to unintended consequences

clinical and analytical validation of FoundationOne liquid CDx, a novel 324 gene blood based comprehensive genomic profiling assay abstract e13685

as the availability of precision therapies expand, a well validated blood based comprehensive genomic profiling [CGP] assay has the potential to provide considerable value as a complement to tissue based testing to ensure that potentially life extending therapies are administered to the patients most likely to benefit. comprehensive clinical and analytical validity data for blood based assays are crucial to enabling physicians to understand the true performance of available testing options.

the foundationOne liquid CDx assay is a blood based CGP assay that has been validated for a pre market approval [PMA] submission to the FDA. Validation studies included > 9,000 tests and > 30,000 unique variants across > 300 genes and > 50 cancer types, allowing for a comprehensive assessment of performance.

the results of these studies demonstrate that foundationOne liquid CDx accurately and reproducibly detects the major types of genomic alterations [short variants, rearrangements, and copy number alterations], as well as complex biomarkers, such as MSI, bTMB, and tumour fraction. these data demonstrate that the assay can identify genomic variants that may inform therapeutic decisions for cancer patients with any solid tumour using a single blood sample. additionally, clinical validation results establish foundationOne liquid CDx as an additional tool for physicians in the therapeutic management of cancer patients.

emerging trends and utilization of patient reported outcomes [PROs] in clinical trials of chimeric antigen receptor [CAR] T-cell therapies

patient reported outcomes [PROs] are an important tool to assess the impact of new therapies on health related quality of life [HRQoL]. this study aimed to describe if and what PRO instruments are currently being utilized in CAR T cell therapy studies in solid and hematological malignancies while assessing the patterns of inclusion and trends of HRQoL data reporting.

citeline was used to search for clinical trials between jan 2008 - jan 2020, excluding planned or terminated studies, non oncology, non treatment, and duplicates. reviewers extracted various parameters for included trials, then cross matched data with EU clinical trials register, clinical trials.gov, trial protocols [when available], and google. the reporting of PRO data was then assessed for those closed | completed trials that included a PRO via pubmed/MEDLINE, sponsor, and google.

a sample of 664 CAR T trials was identified. PROs were included in only 6.17% [41/664] studies. of the 41 trials that included a PRO, 63.41% [26/41] utilized more than one PRO, with the generic EORTC QOL-C30 and the EQ-5D being used predominately. median HRQoL follow up was five

years on most trials. no studies used PROs as primary endpoints. the majority of PROs were observed to be utilized in early phase trials [phase I, 12; phase I/II, 17]. PROs were first incorporated in CAR T trials beginning in 2014, and the utilization rate has increased steadily, except for 2019. PROs were included in three first line trials, 22 second line, five third line, and 11 fourth line or greater. PRO utilization between solid tumour trials and hematologic malignancies was comparable [6.04% [9/149], and 6.26% [32/511]]. of the completed | closed trials, 28.57% [3/14] published PRO data and met at least eight of the CONSORT-PRO quality indicators.

the utilization of PROs in CAR-T trials [6.17%] is under the industry average of 27%, despite the growing importance of HRQoL and its impact on value based care. the findings from this review reflect the overall increased attention to CAR T as a new therapeutic entity and the continued deficiency of including and reporting of PROs in trial designs.

examining the relationship between the clinical benefit of oncology drug indications and the time from pan canadian oncology drug review [pCODR] recommendation to public reimbursement abstract e19360

this study examined if publicly reimbursed oncology drug indications with evidence of high clinical benefit, as measured by the ASCO-VF, and ESMO-MCBS, received reimbursement status faster than those with lower clinical benefit from the time of pCODR recommendation.

oncology drug indications that received pCODR recommendations between jan 2012 and july 2018 were identified. indications that did not receive provincial reimbursement, without notice of compliance [NOC], or received a negative pCODR recommendation were excluded. the relationship between clinical benefit, as measured by ASCO-VF and ESMO-MCBS, and the time to reimbursement was evaluated using spearman correlation coefficient, univariable, and multivariable linear regression analyses.

overall, 84 indications met inclusion criteria yielding 80 ASCO-VF and 66 ESMO-MCBS scores. the mean ASCO-VF and ESMO-MCBS scores were 38.8 [SD = 23.8] and 3.0 [SD = 1.1] respectively. higher ASCO-VF and ESMO-MCBS scores had low correlation with shorter time to provincial funding, [$\rho = -0.15$] and [$\rho = -0.25$] respectively. univariable analyses showed that manufacturer reported incremental cost effectiveness ratio [ICER] values, year of pCODR. after adjusting for potential confounders in the respective multivariable analysis, ASCO-VF and ESMO-MCBS scores were not significantly associated with time to public reimbursement. year of pCODR recommendation remained associated with time to public reimbursement. earlier years [2012-2014] had a shorter time to reimbursement [mean = 10.4 months] than later years [2015-2018] [mean = 14.5 months]. other factors that were associated with time to reimbursement in multivariable analysis were province and cancer type.

currently, oncology drug indication with evidence of high clinical benefit do not appear to be funded faster than those with low clinical benefit. this suggests the need to prioritize cancer drug indications based on clinical benefit in order to allow for timely public reimbursement of cancer drugs with higher clinical benefit to patients.

druggable fusion gene landscape in solid tumors abstract e13517

kinases activated by gene fusions represent an important class of oncogenes in solid tumours highlighted by the unique site agnostic FDA approval of larotrectinib for NTRK gene rearrangements. the frequency and types of druggable fusions in solid tumours are not well characterized from the clinical perspective.

oncofocus is a clinically validated precision oncology platform that includes analysis of 399 druggable driver partner oncogenic fusion genes linked to 140 unique targeted therapy protocols. a retrospective analysis of oncofocus trending data in a real-life cohort of 1111 patients has been used to determine the actionable fusion gene landscape in solid tumours.

89 actionable fusion genes were identified, linked to 73 targeted therapy protocols. seven of the samples harboured multiple fusion genes. 82 of the 1111 samples tested had at least one actionable fusion gene representing a frequency of 7.38%. the highest frequency of actionable fusions were observed in glioblastoma [23%], head and neck [12%], kidney [11%] and prostate [10%] cancers. four of the seven samples with multiple actionable fusions were found in glioblastoma. pancreatic, lung and endometrial cancers and cancer of unknown primary [CUPs] had an actionable fusion gene frequency ranging from 7-9%. TBL1XR1-PIK3CA, MET-MET, WHSC1L1-FGFR1 and EGFR VIII fusions were identified as the most common druggable fusions. all actionable fusion genes were found to interact with one or more of the following pathways RAS/RAF/MEK/ERK, PI3K/AKT/MTOR, PLC γ /PKC and JAK/STAT. although a targeted agent for TRK fusions now has FDA approval, this rearrangement appears to be a rare event. in contrast, inhibitors targeting the TBL1XR1-PIK3CA, MET-MET, WHSC1L1-FGFR1 fusions and linked downstream signalling pathways appear to offer much broader clinical utility.

druggable fusions were identified at an unexpectedly high frequency and should therefore be included as part of routine comprehensive precision oncology testing. notably, many of the actionable fusions are not tumour type specific reinforcing the "site agnostic" approach to profiling and supporting the concept of "molecular basket" clinical trials. precision oncology trending data also provides actionable mutational landscapes which can be used to refine precision oncology testing, patient selection for targeted therapy protocols and enhancement of clinical trial design.

precision medicine is an evolving and dynamic field that has the potential to transform healthcare systems and is increasingly influencing patient outcomes. with the emergence of precision medicine, we have also seen a shift in the definition of value in patient care and in the delivery of patient care.

with the rising healthcare costs, covering the cost of cutting edge testing and emerging therapies is a challenge. Expanding genetic testing availability has the potential to provide more clinical benefit and create sustainability while optimizing patient care. as the oncology landscape develops, financial models to account for high initial costs will be necessary. value must be redefined. at its core, value based healthcare is paying for successful outcomes and precision medicine helps to identify appropriate treatment pathways based on each individual patient. precision medicine provides the platform for which payors, providers and pharma can come together and align on the singular goal of best care for the individual patient.

currently, there is a mismatch between the progress being made clinically and the infrastructure to provide access - NGS and other diagnostic tests are rapidly expanding, and we are increasingly seeing phase II data. Our HTA process and reimbursement pathways will need to adapt to this changing landscape. we are at the junction where we need to deliver better care at a better cost to create sustainability in our healthcare system.

it's time to use technology to transform our healthcare systems to focus on the individual patient - this is the future of medicine.

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