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Using Big Data in oncology to prospectively impact clinical patient care: A proof of concept study

Vérène Dougoud-Chauvin, Jae Jin Lee, Edgardo Santos², Vonetta L Williams, Nicolò ML Battisti, Kavita Ghia, Marina Sehovic, Cortlin Croft, Jongphil Kim, Lodovico Balducci, Julie A Kish, and Martine Extermann

H. Lee Moffitt Cancer Center and Research Institute, Tampa, FL, USA

²Lynn Cancer Institute, Boca Raton, FL

Abstract

Introduction—Big Data is widely seen as a major opportunity for progress in the practice of personalized medicine, attracting the attention from medical societies and presidential teams alike as it offers a unique opportunity to enlarge the base of evidence, especially for older patients underrepresented in clinical trials.

Objectives—To prospectively assess the real-time availability of clinical cases in the Health & Research Informatics Total Cancer Care™(TCC) database matching community patients with cancer, and the impact of such a consultation on treatment.

Address for correspondence: Martine Extermann, MD, PhD, Senior Adult Oncology, Moffitt Cancer Center, 12902 Magnolia Drive, Tampa, FL 33612, USA, Telephone: +1(813)745-3822; Fax: +1(813)745-1908, martine.extermann@moffitt.org.

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Methods—Patients aged 70 and older seen at the Lynn Cancer Institute (LCI) with a documented malignancy were eligible. Geriatric screening information and the oncologist’s pre-consultation treatment plan were sent to Moffitt. A search for similar patients was done in TCC and additional information retrieved from Electronic Medical Records. A report summarizing the data was sent and the utility of such a consultation was assessed per email after the treatment decision.

Results—Thirty one patients were included. The geriatric screening was positive in 87.1%(27)of them. The oncogeriatric consultation took on average 2.2 working days. It influenced treatment in 38.7% (12), and modified it in 19.4% (6). The consultation was perceived as “somewhat” to “very useful” in 83.9% (26).

Conclusion—This study establishes a proof of concept of the feasibility of real time use of Big Data for clinical practice. The geriatric screening and the consultation report influenced treatment in 38.7% of cases and modified it in 19.4%, which compares very well with oncogeriatric literature. Additional steps are needed to render it financially and clinically viable.

Keywords

Electronic database; electronic consultation; Big Data; cancer; elderly; geriatric oncology; personalized medicine; precision medicine; Total Cancer Care; Health & Research Informatics

Introduction

Big Data is widely seen as a major opportunity for progress in the practice of personalized medicine, attracting the attention from large medical societies and presidential teams alike as it offers a unique opportunity to enlarge the base of evidence, especially for older patients. Big Data can be generally defined as “a very large set of data collected in a structured fashion, and retrieved via analytic software.” More specifically in our setting, a medical, biological, or population data set that is relevant to older patients with cancer. Best oncology practice typically involves using evidence obtained from clinical trials. However, older patients with cancer are underrepresented [1]. In fact, systematic cohort reviews have shown that a significant number of older patients with cancer would not have matched study eligibility criteria, limiting the validity of the guidelines based on such trials[2–4]. Clinical trials also rarely include elements of a geriatric assessment. Big Data offers a unique opportunity to enlarge the base of evidence upon which to treat these patients. Through the consultation of such a large-scale database (e.g. Total Cancer Care (TCCTM), ORIEN (Oncology Research Information Exchange Network) or CancerLinQ) for similar patients, oncologists might be able to retrieve a custom-tailored retrospective case series to rely on for decision making, thus moving from level 5 evidence (expert consensus) to level 4 (case series). Yet, a key issue is making data meaningfully available for every day clinical practice. In this study, we tested the use of one of the most developed clinical and biological databases in oncology: TCC, which contains data on more than half a million patients to date, including cancer and patient characteristics, including some geriatric data [5]. At Moffitt Cancer Center (MCC) TCC data is stored on a Health & Research Informatics (HRI) platform, an enterprise wide data warehouse which utilizes a Business Intelligence Tool to access the data. We leveraged that resource to assess the feasibility of real time electronic consulting for a community clinical practice.

Methods

As a proof of concept, we tested a model of approach and gained feedback on subjective utility and objective treatment modification profiles, in order to target a future study towards the stakeholders most likely to benefit. Our outcomes reporting was modeled on the approach used by the National Oncology PET Registry (NOPR) to assess the impact of supplemental information on treatment decisions and establish indications for PET scan use and coverage by Medicare[6–9]. Patients' characteristics were summarized with median and range for continuous data, and frequencies and percent for categorical data. The 95% confidence intervals for binary variables were computed by the Clopper-Pearson method.

Preliminary data

We tested the availability of patient data in HRI to match with clinically significant decision-making scenarios in older patients in a preliminary work[10]. The matching method was the same as described below in the Methods section. Table 1 lists the chosen scenarios. This work allowed tracing the most effective way of retrieving and formatting information.

Prospective study

Prospectively we tested the intervention with one community center, a member of the Moffitt Oncology Network (MON), the Lynn Cancer Institute (LCI) in Boca Raton, Florida. Under the MON office, LCI conducted standardized procedures for quality control of research.

Eligibility

Initially, the study aimed at screening all new patients aged 70 and older with a documented malignancy seen at LCI and needing a treatment decision. Patients were excluded if they were unable to consent or to complete the study questionnaires (assistance for physical impairment permitted) or if an urgent treatment decision was needed. However, user feedback was that the consultation would be perceived as most helpful for established patients, particularly beyond the first line of treatment. Therefore, we amended the criteria to include patients needing a treatment decision at all stages of treatment, as deemed fit by the oncologist.

Research procedures

The study scheme is shown in Figure 1. At LCI, a geriatric screening, the Senior Adult Oncology Program questionnaire version 2 (SAOP2), was first applied to patients who consented to the study. This empirical tool was developed by a multidisciplinary team from the SAOP at MCC to determine when a multidisciplinary consultation was required for new patients. In addition to function, depression and cognitive screening, the survey includes questions regarding quality of life, self-rated health, falls, nutrition, sleep, polymedication, and social questions. Its performance is validated against a multidisciplinary geriatric assessment (MGA)[11–13]. If the screening was positive, a short form of a CGA (Comprehensive Geriatric Assessment) was administered. It included questions on Activities of Daily Living (ADL)/Instrumental ADL (IADL) to allow a potential use of a Chemotherapy Risk Assessment Scale for High-Age Patients (CRASH) score[14], a Mini

Nutritional Assessment (MNA)[15] and a Folstein's Mini Mental Status Examination (MMSE)[16]. A web based version of those questionnaires was elaborated in collaboration with the Moffitt Survey Core and a tablet computer was provided to LCI in order to complete the questionnaires online, linked to a central database at MCC. Backup paper questionnaires were also provided.

Comorbidities were recorded per organ system according to the Cumulative Illness Rating Scale- Geriatric(CIRS-G) [17] by the LCI team. The grading and scoring was done at MCC using the online CIRS-G calculator.

LCI sent the information to the Oncogeriatric Information Team (OGIT) at MCC electronically, as well as a preconsultation email that included the oncologist's pre-consultation treatment plan and specific comments. The capture of the intended treatment followed the format used by Decoster et al.[18]. The pre consultation email contained informations about the diagnosis (tumor type, tumor stage and comorbidities). Then the LCI oncologist had to document if the treatment planned was "standard dose", "standard type", "less toxic type" or "less toxic dose" concerning chemotherapy or concerning radiotherapy or surgery "standard", "less extensive", "delayed" or if the oncologist would offer best supportive care only. The email was made of several tables and the LCI oncologist had to check the appropriate boxes. The OGIT consisted of a clinical research coordinator (CRC) and three medical oncologists (Dr. Dougoud, Dr. Lee, and Dr. Battisti) working as visiting international scholars (hereafter "junior investigators"), under the supervision of an experienced geriatric oncologist (ME, LB, or JK) (hereafter "senior investigators").

OGIT entered the received data in a secured database kept on a MCC server. The junior investigators preformatted a request using the Transmed portal to retrieve similar patients regarding age at diagnosis (default +/- five years), disease site, histology, and stage. A data concierge from the Collaborative Data Services Core (CDSC) extracted the patient's cohort created in Transmed from HRI and provided the list, including Medical Record Number (MRN), to the OGIT within 24 hours. Age at diagnosis, performance status, gender, stage, primary site, date of diagnosis, first course of chemotherapy, date chemotherapy started, date of death or last contact date at MCC, vital status at last follow-up, overall survival time, and histology were also retrieved. The junior investigators recorded additional information regarding baseline assessment, comorbidities, geriatric issues, treatment and follow-up from the Electronic Medical Records (EMR), summarized matching patients in a report and integrated relevant literature. The report sent to the treating oncologist included a summary of the case submitted, the variables used for matching, and the number of patients retrieved in TCC database. The details of the matching patients were summarized in a table containing age, comorbidities/geriatric issues, treatment, tolerance and outcome in term of DFS and OS (figure 2 = example of a report). Finally, the report included an expert summary and interpretation of the data, including comments on missing information if significant, with relevant literature if appropriate. The report only included de-identified information following the rules employed when writing case report articles (no dates or names, generalization of treatment details). The report was reviewed and signed from one of the Senior Investigator and emailed back to the LCI oncologist.

Two weeks later, OGIT sent a post consultation email to the LCI oncologist in order to assess the final treatment plan as well as the utility of the geriatric assessment and the consultation in the patient management. In the post consultation email the LCI oncologist had to attest if anything had changed in the diagnosis (tumor type, tumor stage and comorbidities). Then it was asked to document if the definitive treatment plan was “standard”, “less toxic” concerning chemotherapy or “less extensive” concerning radiotherapy or surgery or if the oncologist renounced to this treatment. It was then asked if this was changed from initial plan and if yes how. The last questions on the post consultation were to know if the geriatric screening alone and the OGIT consultation helped for the decision and to rate the subjective usefulness of the consultation as “very useful, useful, somewhat useful, or not useful”.

Every electronic communication between LCI and MCC was secured. The central Liberty Institutional Review Board in DeLand, Florida, approved the study after full board review.

Endpoints

The first aim was to assess the impact of the consultation on treatment plan (with pre- and post-emails) as well as the availability of similar patients in the database. The oncogeriatric literature describes impact rates of 20–50% for geriatric screening/consultations [18–23], so we expected the OGIT consultation to influence the treatment plan in at least 20% of cases. Based on our preliminary work [10], we expected similar patients to be available in >80% of the cases, on average six patients per case.

The second aim was to measure the workload needed for such a consultation (local and central staff), evaluate the time constraints and test the feasibility of a three working days turnaround time.

Results

Baseline characteristics

Thirty two patients were consented. One patient was a screen fail (malignancy not confirmed on pathology review at LCI), leaving 31 eligible patients enrolled. Patients' characteristics are represented in Table 2. Median age was 79 years old which is well representative of older patients with cancer. The most frequent diagnoses were lung and GI cancer. Two thirds of the patients were previously treated with a first line of therapy, meaning that this consultation seems to be interesting also in later treatment lines.

The SAOP2 screening questionnaire was positive in 27 patients (87.1%), suggesting that the majority of the patients may suffer from a geriatric syndrome. Self-rated quality of life, self-rated overall health, dependence in ADL/IADL, malnutrition, and sleep problems were the issues most frequently described. The discrepancy between a positive geriatric assessment and the rating of ECOG 0–1 for all patients is a well-known observation in geriatric oncology and a strong argument for the use of a geriatric screening[12, 24]. A summary of patient comorbidities and geriatric issues is represented in Table 3. On average, four comorbidity categories were endorsed per patient, cardiovascular comorbidities were the most encountered comorbidity, present in 80% of the patients.

Change of treatment from initial plan after consultation and helpfulness of TCC

The OGIT consultation influenced treatment in twelve patients (38.7%) (95% CI: 21.8% – 57.8%), and modified it for six patients (19.4%) (95% CI: 7.5% – 37.5%). Since the initial email was sent after the geriatric screening, the changes truly reflected the OGIT impact. The characteristics of these six patients are represented in Table 4. There were two different evaluation questions asked to the LCI oncologists. The first was “Did geriatric screening help with decision” was answered “yes” in 35.5%. The second was “Did OGIT consult help with decision was answered “yes” in 38% and reflects the influence of the OGIT consultation on the treatment decision. The usefulness of the intervention overall was perceived as “somewhat” to “very useful” for 26 patients (83.9%), “useful” to “very useful” in thirteen (41.9%).

The geriatric screen alone helped with decision for eleven patients (35.5%). For the patients for which one or more geriatric syndromes was described, the OGIT report contained some information about those geriatric syndromes encountered in the matching patients as well as geriatric suggestions when appropriate.

Consultation Timeline

OGIT sent a request to the CDSC team, conducted the analysis of the matching patients after having received back the cohort, shaped the summary, searched the related literature, and sent a report to the treating oncologist within a mean time of 2.2 working days for the whole process (min 1, max 5, median 2).

Matching patients in TCC database

The process involved a junior investigator constructing a cohort of patients with the desired characteristics through the de-identified HRI data warehouse portal. With experience, we identified a filtered sample size of around 50 to 80 patients as an optimal number to aim for in order to receive both a feasible workload to process and a sufficient number of patients to be relevant for the consultation report. If the initial cohort was larger, we narrowed criteria such as age at diagnosis or date of treatment. The patient cohort was then retrieved and processed by the data concierge. OGIT received an average of 76 patients per case (min 25, max 352). This number dropped to a median number of nine (min 3, max 28) after full manual chart review.

Other workload and feasibility results

Enrollment and geriatric screening—Our initial design was based on the current practice in MCC’s Senior Adult Oncology Program (SAOP), where every new patient receives a SAOP2 screening that is integrated in the initial treatment plan. This approach proved however relatively poorly adapted to a private practice setting. LCI oncologists were referred a large number of undiagnosed patients, as well as numerous non-malignant hematology cases. Therefore, we modified our approach from a general initial screening to a targeted screening of both new and established patients needing a treatment decision.

Workload assessment—The creation of the de-identified patient cohort was very time effective, taking about 10 minutes. The staff time needed by the data concierge to retrieve

and format the HRI data was about 2 hours. The junior researcher's time to review the data and create a consultation report was about 3 hours. The senior researcher took about 10 minutes to review and vet the report. Over its eleven months duration, the consultation model proved robust to staff turnover and vacations, with a stable turnaround time.

Discussion

This study establishes a proof of concept as to the feasibility of real time use of Big Data for clinical practice. We were able to provide information for all patients but 1 within our target time frame of three working days. It also established that a database of over 502,000 patients contained enough similar patients to offer a meaningful set of comparison.

The geriatric screening and the consultation report were judged “somewhat” to “very” helpful in 83.9% of cases (26 patients) by the community oncologist. The OGIT consultation influenced treatment in 38.7% of cases (twelve patients), and modified it in 19.4% (six patients). This compares very well with the oncogeriatric literature that describes impact rates of 20–50% for geriatric screenings/consultations [18–23], although our sample size is small and confidence intervals are wide.

Geriatric screening tools and geriatric assessment provide a wealth of relevant information in patients with cancer [12, 24]. We made the hypothesis that patients with significant geriatric problems and comorbidities were more likely to benefit from the OGIT consultation. Five out of six patients in our series for whom the treatment plan was changed had at least one geriatric issue, and all had comorbidities. Therefore the OGIT consultation appears to meet a perceived need in oncology settings where a full oncogeriatric clinic is not available. Using electronic data to improve patient care is a topic that is generating interest at the highest political and medical level. The application of big data to health care is inevitable. Our study contributes a crucial piece of information to the debate. So far most efforts have focused on building the integrated databases and formatting data entry[25, 26]. Data retrieval efforts have mostly been conducted in the research setting, where time is a secondary consideration. This study is to our knowledge the first to test the feasibility of data retrieval for the ultimate intended use of this massive effort: real-time individualized clinical patient care. It can provide a framework upon which to build further clinical use of medical Big Data, particularly in an oncology setting.

Our study targets a population that has long been underserved by clinical trials: older patients with cancer, especially those with comorbidities and geriatric problems. In the future, such an approach to evidence generation might allow developing treatment pathways and recommendations that would be impossible to generate through classic clinical trials. This successful proof of concept will, as a first step, allow the conduct of larger studies exploring the impact of a database-assisted treatment on patient outcomes.

However, several steps are still needed to make this consultation a financially and clinically viable proposition for large scale use. Foremost is the fact that one consultation took five to six hours of staff time on average. As the ratio of cases identified to cases matching when perusing the EMRs was 10 to 1, a significant opportunity for efficiency lies in better

matching the search strategies. Major improvements would be the ability to reliably identify lines of treatment in the search engine, and the availability of dates of relapse in the database as well as preformatted search filters combining International Classification of Diseases(ICD) 9 and 10 codes for comorbidities. The molecular tumor characteristics will become increasingly searchable in electronic databases, and efforts are underway to increase the direct electronic retrievability of itemized geriatric data in TCC. In our study, the search was mostly conducted by physicians on Moffitt's Advanced Visiting Scholars Program (VD, JJJ, and NB). However, a preselection of the data would be feasible by a CRC or a clinical data analyst, reducing physician time and costs. The TCC database only has at this time a limited number of searchable geriatric elements. The inclusion of more geriatric variables would also allow better relevance and easier matching of older patients with cancer. Efforts are being made to include more geriatric questions in Moffitt's electronic patient questionnaire, and making the SAOP2 searchable in an itemized fashion.

Our high screening to usable patient ratio also points toward another reality of Big Data use for clinical care. The complexity of medical information, especially in older patients with multimorbidity, will require for a long time to come, if not durably, a significant human compiling of the data by a medically qualified staff. "Data extraction at your fingertips" in the daily clinic flow might only work for very straightforward cases. Less ambitious projects such as tailored information linking to pathways and guidelines are more feasible and already in the works in our system and others such as CancerLinQ.

For this project, we used the outcomes approach that was tested to assess the meaningful use of Positron Emission Tomography (PET) scans in clinical practice [9]. Our results compare very well with those of the National Oncologic PET Registry. The changes in the intended management after the use of PET/CT is described between 16% and 50% and we could demonstrate a change of the initial plan in about 20% of patients. Even if the treatment plan was not changed, clinicians found the consultation useful in most cases by raising the level of evidence and confidence in their decision making.

Conclusion

This study provides a proof of principle foundation on which to build real time Big Data teleconsultation. This avenue is particularly promising for older patients with cancer with complex issues, for whom data from clinical trials and subsequent guidelines recommendations are not straightforwardly applicable [4]. Such data were deemed useful by community oncologists, with significant impact on treatment choices, using a methodology similar to the one that led to the expansion of Medicare's approval of PET scan indications for infrequent tumors. Future developments include refining data formatting and search strategies to decrease staff time requirements, as well as developing testing in a multicentric setting with longer term outcome end-points. Large scale database systems such as ORIEN or CancerLinQ appear promising venues for this type of endeavor.

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Figure 1. Consultation flow chart

(I)ADL = (Instrumental)Activities of Daily Living; CIRS-G = Cumulative illness rating Scale-Geriatric; LCI = Lynn Cancer Institute; MCC = Moffitt Cancer Center; MMS = Mini Mental Status; MNA = Mini Nutritional Assessment; OGIT = Oncogeriatric Information Team; QOL = Quality of life; SAOP2 = Senior Adult Oncology Questionnaire 2; TCC = Total Cancer Care

Study ID: [REDACTED]
Initials: [REDACTED]

91 year old man with recurrent TCC bladder cancer.
S/p intravesical BCG therapy (2007 and 2009), S/p TURBT (2013), S/p XRT (2014)
ECOG PS 1.
Major comorbidities: HTN (G2), Hypercholesterolemia (G2), Hypothyroidism (G1), Diabetes mellitus (G1)
Geriatric issues: moderate decrease of quality of life, MMS 29/30, MNA 27/30, IADL 26/29.

Findings:
Matching patients: 8

Interpretation:
We found 8 patients approximately matching your case. Three patients relapsed after local treatment. Although chemotherapy was discussed, all declined and chose Hospice. Two patients had chemoradiation therapy at age 86 and 89 for their initial disease, well tolerated. Survival after relapse was 2-7 months. We published a retrospective review of nonagenarian patients treated at Moffitt [1]. Thirty did receive chemotherapy, mostly single agent. Half received standard dose, half reduced dose. Treatment-related mortality was low.
Your patient's CRASH score indicates a medium-low (medium high if his LDH is >0.75 ULN) risk of G4 hematologic toxicity and a high risk of G3-4 non-hematologic toxicity. <https://moffitt.org/test-treatments/treatments/senior-adult-oncology-program/senior-adult-oncology-program-tools> [2]
Based on the above information, chemotherapy may be given, but we would advise prudent dosing and close monitoring for toxicity, as the patient is almost certain to experience G3-4 non-hematologic toxicity.

Details
Age range: 84-93 at diagnosis
Sex: both
Date of diagnosis: 2010-2015
Diagnosis: Bladder cancer (transitional), stage 2-4, recurrent (may be recurrence after superficial BC)

Treatment/outcome table
Prior episodes of superficial bladder cancer not listed

Age /Sex	P /S	Comorbidity/ Geriatric issues	Treatment	Tolerance of therapy	Outcome of therapy	FFS (mo)	OS (mo)
84/M	1	Kidney stones, UTI, BPH, pneumonia, apnea, hernia, prostate ca	Radical cystectomy (T2N0M0) Unknown adjuvant treatment (moved out of State)	good	NED	2+	15+
85/M	1	HTN, BPH	Radical cystectomy	good	NED	3+	17

Study ID: [REDACTED]
Initials: [REDACTED]

Age /Sex	P /S	Comorbidity/ Geriatric issues	Treatment	Tolerance of therapy	Outcome of therapy	FFS (mo)	OS (mo)
86/M	1	heart valve sx, cataract sx Atrial fibrillation, pacemaker, polymyalgia rheumatica, constipation, gout, renal stones, HTN, UTI, cataract sx, aortic aneurysm	(T3bN0M0) rec. chemo-XRT, lost to fu Initial: TURBT, weekly carbo AUC1 + XRT Relapse: J-stents. Single agent chemo discussed but chose Hospice.	NA	G1 neuropathy, CR thrombopenia, temporary indwelling cath.	10	17
86/M	0	Parkinson's disease, CAD, HTN	Hospice		NA	NA	6
88/F	1	CAD, ltx of PE, DVT, GERD, pacemaker	Cystectomy for T3bN0M0 Relapse: NONE (poor PS)	good	CR	9	15 (post-relapse 6)
89/M	0	CAD, Aortic valve replaced, CAGBx2	TURBT, Carbo-gem x2 Wk Cisplatin + XRT	Hosp for infection after C2. Very good	CR	12	13 (post-relapse 1)
90/F	3	HTN, Hypercholesterolemia, Kidney failure, osteoarthritis, colon ulcer	TURBT for 6cm lesion, T3N0M0 Mets, patient chose Hospice	Hematuria, AKI	UNK	2	4
93/M	0	CAD, CAGBx4, Afib	TURBT, chemo/XRT outside. Hospice	Poor, interrupted for pancytopenia, poor tolerance.	NA	NA	9+

Abbreviations:
 - BPH, benign prostate hyperplasia
 - CAD, coronary artery disease
 - COPD, chronic obstructive pulmonary disease
 - HTN, hypertension
 - Maint., Maintenance
 - NA, Not available
 - N, Negative
 - P, Positive
 - PS, ECOG performance status at second-line therapy
 - UK, unknown
 - YA, years ago

References of potential interest:
 1. Extermann M, Crane EJ, Bouwmeester D. Cancer in nonagenarians: profile, treatments and outcomes. *Journal of Geriatric Oncology* 2010; 1: 22-31.
 2. Extermann M, Boler J, Reich RR, et al. Predicting the risk of chemotherapy toxicity in older patients: the Chemotherapy Risk Assessment Scale for High-Age Patients (CRASH) score. *Cancer* 2012; 118: 3377-3386.

Signature: [REDACTED] Date: [REDACTED]

Figure 2.
example of a report

Table 1
Preliminary vignette scenarios used for feasibility assessment

We presented a list of fifteen hypothetical scenarios to colleagues and asked them to rank the potential utility of a real-time consultation. For the five highest ranking scenarios, we extracted patients with similar disease, stage, age, and comorbidity/functional status as applicable. We generated a summary report for each case.

Scenarios	Ranked utility (median from 0 to 10)	# of matching patients	User comments
82-year old man Diagnosis: diffuse large B cell lymphoma Comorbidity: ejection fraction of 43% stage 3 renal insufficiency	8	93 cases in HRI 6 valid cases	
88-year old woman Diagnosis: breast cancer, triple negative Stage: III Comorbidity: in average health Treatment: surgery	7.5	7 cases in HRI 5 valid cases	
82-year old man Diagnosis: acute lymphoblastic leukemia Molecular: Philadelphia (+) Comorbidity: in good health	8	7 cases in HRI 2 valid cases	
83-year old man Diagnosis: oral cancer, status post surgery Stage: T2N1 Molecular: Human papilloma virus (–) Comorbidity: myocardial infarction with 2 stents, weight loss of 20 lbs after surgery	7.5	12 cases in HRI 6 valid cases	For scenarios 1 to 4, the results were highly manageable. The search provided 7 to 93 cases per scenarios. The chart review narrowed it down to 2 to 7 matching patients
77-year old man Diagnosis: lung adenocarcinoma Stage: IV Molecular: EGFR unmutated, ALK (–) Performance status (PS): ECOG 2 Comorbidity: weight loss of 5 pounds	7.5	1845 cases in HRI 5 valid cases	The search provided 1845 patients. The age range was narrowed to get down to a manageable number of cases.

ALK: Anaplastic lymphoma kinase; ECOG PS: Eastern Oncology Cooperative Group Performance Status EGFR: Epidermal growth factor receptor; HRI: Health Research Informatics datasheet

Table 2

Patients demographic and clinical characteristics at time of accrual, N=31)

		Number	(%)
Total		31	100
Age			
Median	79		
Range	70–98		
Gender			
Male		14	45.2
Female		17	54.8
Cancer Site			
Breast		3	9.7
Gastro-intestinal		9	29.0
Genitourinary		2	6.5
Gynecological		2	6.5
Lung		9	29.0
Myeloma		2	6.5
Skin		4	12.9
Cancer Stage (at diagnosis)			
I		5	16.1
II		3	9.7
III		8	25.8
IV		13	41.9
Unknown		2	6.5
ECOG PS *			
0		16	51.6
1		15	48.4
New Patient			
Yes		10	32.3
No		21	67.7
SAOP2 **			
Positive		27	87.1
Negative/consult requested		4	12.9

* ECOG PS = Eastern Oncology Cooperative Group Performance Status

** SAOP2 = Senior Adult Oncology Program Questionnaire version 2

Table 3
Most frequent comorbidities and geriatric issues encountered in the study patients

On average, four comorbidity categories were endorsed per patient, with a minimum of one and a maximum of ten categories. The mean CIRS-G total score was 7 (minimum 1, maximum 16) and the mean severity index was 1.798 (median 1.8, minimum 0, maximum 2.7). Eighteen patients (58%) had at least one level three comorbidity, none had a category four.

Comorbidities (most frequent)	Patients	
	N	%
Cardiovascular	25	80.6
Hypertension	19	61.3
Cardiac	18	58.1
Respiratory	5	16.1
Renal	8	25.8
Endocrine	6	19.4
Other malignancies	5	16.1
Positive screening for geriatric issues:		
Depression	9	29.0
Self-Rated QOL (<8/10)	17	54.8
Self-Rated Overall Health (<8/10)	16	51.6
ADL/IADL dependence	15	48.4
MMS screen (<10/12)	8	25.8
MNA at risk/malnourished	15	48.4
Financial issues	0	0
Sleep problem	12	38.7

(I)ADL = (Instrumental)Activities of Daily Living; MMS = Mini Mental Status; MNA = Mini Nutritional Assessment; QOL = Quality of life

Table 4
 Characteristics of the 6 patients for whom the treatment was modified after OGIT consultation

Age	Diagnosis	Stage	Comorbidity (CIRS-G Score)	Geriatric issue	First line treatment	Pre-OGIT Intended treatment	Modified treatment after OGIT consultation	OGIT consult helpfulness
74	Colon AdenoCA	IIIB	1	None	Yes	Standard dose chemo	Less toxic dose chemo	Useful
90	Colon AdenoCA	IIIB	5	Malnutrition	Yes	Reduced dose chemo	No chemotherapy	Somewhat useful
70	Malignant melanoma	IV	11	Malnutrition	Yes	Standard dose chemo	Immunotherapy	Useful
74	Rectal Cancer, SCC	Unknown	4	Malnutrition Risk of fall	Yes	Standard dose	Standard dose radiochemo	Very useful
82	mCRPC	IV	10	None	No	Chemotherapy	Standard dose targeted therapy	Useful
91	TCC Bladder Cancer	Recurrent localized	7	Partially dependent in ADL, decrease QoL	No	Standard dose chemo	Reduced dose chemotherapy	Very useful

Geriatric issues = signs of geriatric syndromes (malnutrition, depression, cognitive impairment, dependence in activities of daily living, physical impairment...)

AdenoCA = adenocarcinoma; ADL = Activities of Daily Living; QOL = quality of life; SCC = squamous cell cancer; mCRPC = metastatic castration resistant prostate cancer; TCC = transitional cell carcinoma