

The effectiveness of an independent anti-neoplastic medication therapy management system

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Abstract

Background: Cancer has been a serious health threat for human especially in developing countries. As the tumor patients are largely in elderly population, the ongoing trend of population aging and increased long-term cancer survivors will add complexity to tumor patients management. However, the tumor patients, aged and with multiple therapeutics, are largely under-served in medication service in China. The aim of this study was to evaluate the effectiveness of an independent anti-neoplastic medication therapy management system for tumor patients management.

Methods: An independent, anti-neoplastic medication therapy management (MTM) system, in Shanghai Jiao Tong University affiliated sixth People's Hospital, was established in 2018 as a result of collaboration of onco-chemotherapy, clinical pharmacy and software engineers. The system consists of an independent clinic of pharmacy and MTM software. The software consisted of six modules to enable clinical pharmacists to serve the patients. The six modules are medication therapy review, intervention plan, personal medication record, medication-related action plan, intervention and/or referral, and documentation and follow-up.

Results: In a year, 173 tumor patients visited the pharmacy clinic and the averaged clinic visiting count was 2.4 for the all tumor patients. Two thirds patients (117/173) were with one or more identified drug-related problems (DRPs) in medication therapy review. Three leading DRPs are adverse drug reaction, potential drug-drug interaction and non-adherence. Seventy percent of DRPs could be resolved (cure or improved) in four weeks; the medication adherence reached 84%-100% following three or four round of review and intervention.

Conclusions: The involvement of clinical pharmacists in polypharmacy tumor patients management increased the communication with oncologists, and could ultimately enhance the effectiveness, safety and rational use of medication.

Background

In most countries the cancer incidence are on the rise since 1990s, and the cancer grew into the second leading cause of death in 2013 despite substantial progress has been made in prevention and treatment [1]. From 2006 to 2016, the cancer cases increased by 28 % and reached 17.2 million worldwide, which resulted in 8.9 million deaths [2]. This threat is particular severe in developing countries whose health systems are usually ill-equipped to cancer diagnosis and treatment [1, 3]. By using the same methods of global burden of disease 2017 eight types of cancer appeared in the 25 leading causes of death in China and the estimated deaths for these eight types of cancer summed up to 148 deaths per 100000 population [4]. An ongoing population aging trend in China and increased long-term cancer survivors will add complexity to tumor patients management and severity to cancer morbidity and mortality [5].

As the tumor patients are largely in elderly population, it is common they are also suffering from multiple other diseases and/or organs' dysfunction [5]. As a consequence they required multiple medications, in

turn the tumor patients will easily fall into a vicious circle due to adverse reaction of drug treatments or deterioration of tumor associated metabolic dysfunctions [6]. Patients with multiple medications increased the risk of adverse events, overdose, drug irrational uses, drug-drug interactions, and declining of compliance rate [7–9]. The number of medications dispensed could predict the serious drug-drug interactions independently [10]. Due to the complexity of treatment options and the discrepancy among patients, about half patients receiving long-term oral chemotherapy failed to complete medication adherence [11]; and DRPs could be detected in around 3/4 long-term polypharmacy patients [12]. The intervention conducted by pharmacists could greatly improve the adherence rate of oral anti-neoplastic drugs, and ultimately improve the outcomes of oral chemotherapy [13, 14]. A systematic review of studies of clinical medication review service in Australia confirmed its positive role in improving the quality use of medications and health outcomes and called for collaborations from different health professional backgrounds; on the other hand, a substantial population was still underserved including patients with poor medication adherence, older males, recipients of palliative care and younger patients with chronic disease [15].

The tumor patients, aged and with multiple therapeutics, are largely underserved in medication service in China. In 2018, China National Health Commission issued a guideline on development of pharmaceutical service, required the role transformation and emphasized the professional service provided by pharmacists [16]. In the same year, the first anti-neoplastic pharmaceutical clinic in Shanghai was established to improve the medication adherence, to promote drug rational use, to prevent adverse reactions. This clinic will serve tumor patients independently by following the mode of medication therapy management (MTM) service in which an independent workstation was developed with the ability to retrieve information from the hospital information systems. In a year the tumor patients improved their drug adherence and some short term health outcomes.

Methods

The independent anti-neoplastic MTM system

The independent anti-neoplastic MTM system, in Shanghai Jiao Tong University affiliated sixth People's Hospital, was a product of intramural collaboration between departments of onco-chemotherapy and clinical pharmacy. The system consists of a clinic of pharmacy, designated clinical pharmacists, supportive equipment, MTM software and tumor patients with multiple medications. The MTM software (intellectual property registration No.: 2018SR916520) was design by adopting the concept of patient-centered approach to medication management service [17]. The software consisted of six modules, namely medication therapy review (MTR), intervention plan, personal medication record (PMR), medication-related action plan (MAP), intervention and/or referral (I&R), documentation and follow-up (DFU), and supplement scores for assessment in modules. Through MTM software the clinical pharmacists can retrieve the information from hospital information system and the structured data of medication history will be extracted automatically and presented in table format. As consequence, the clinical pharmacists can management the tumor patients in a formulated procedure and get support from

the data of medication history and from oncologists online, which to enhance the safety, compliance and ultimately the outcomes in medications (Figure 1).

Patient management procedure

Following the registration, a patient's baseline information, disease treatment history, list of medication, adverse events, status quo of health and electronic medical records will be collected and retrieved. The clinical pharmacists are able to review the history of medication therapy in MTR module in descending priority of medication (contra)indication, efficacy, safety, compliance, drug-drug interaction and other drug-related problems (DRPs). Nine types of DRPs covering indication, effectiveness, safety and adherence include (1) drug without indication; (2) indication without drug; (3) inappropriate drug; (4) underdose; (5) adverse drug reaction; (6) overdose; (7) non-adherence; (8) potential drug-drug interaction, and (9) other problems [18, 19]. For those without DRPs a pre-admission assessment will be conducted before hospital-based chemotherapy. For those with DRPs a detailed medication-related action plan will be provided after a consensus between clinical pharmacists and oncologists. Based upon the action plan the patients are able to learn their own DRPs and to monitor the effectiveness of action plan through daily records. During the patient management process questionnaires on knowledge, attitude and practice of medications or related problems will be applied (Supplement table s1 Pharmaceutical service intention survey). As a part of action plan the patients are scheduled to repeat review, assessment and evaluation of laboratory tests, prescription and treatment outcomes (including cure, stable status, improved, partial improved, no improvement, deterioration, failure). From the second review onward the Morisky medication adherence scale (MMAS-8) is provided for tumor patients with serious DRPs (Figure 1) [20].

Patients

The independent anti-neoplastic MTM system recorded 173 consecutive patients from Jun 6th 2018 to May 31st 2019. In this retrospective analysis only patients with three or more round MMAS-8 score, largely were receiving chemotherapy in our own hospital, are used to assess the medication compliance following execution of action plan. The data were collected during the patients management as depicted in patient flowchart (Figure 1).

Statistical analysis

Continuous variable was presented as mean (SD), categorical data was presented as count (percentage). The chi-square test or fisher exact test were used to compare the proportions of different groups. The DRPs are usually data of time-to-event and the Kaplan-Meier method is used in estimating the median time of those with endpoints of cure or improved (defined as event = 1). The patients with MMAS-8 score ≥ 6 is regarded as adherence of acceptable level (defined as event = 1), also the median time of patients

reached the level of acceptable adherence was estimated by using Kaplan-Meier method. A significant level of $\alpha = 0.05$ was used in two tailed statistical test. Statistical analysis was performed by using software of SPSS 18.0 (IBM Corp. Armonk, NY).

Results

Baseline characteristics

The tumor patients aged from 4 to 86 year with mean (SD) of 49.4(22.3) years, greater than 60% patients are in groups of 18–70 years of age. It's worth to note that around one sixth were occurred under 18 years and one fifth were above 70 years of age. Female patients consisted of half of all the patients (chi-square test, $p = 0.595$). Five leading types of cancer were bone, lung, breast, colorectal and prostate cancer. On average patients with one or more comorbidities and DRPs. Three leading DRPs are adverse drug reaction, potential drug-drug interaction and non-adherence, one third of DRPs were adverse drug reactions (Table 1).

Patients follow-up

Following medication therapy review, two thirds patients (117/173) were with one or more identified DRPs. These patients were scheduled to review and re-evaluation, among them 47% (55/117) revisited the MTM clinic once or more. The averaged clinic visiting count was 2.4 for the all tumor patients. A few patients visited the MTM clinic greater than ten times in a year (Figure 2).

Improvement in patients with DRPs

One hundred and seventeen patients were identified with 190 DRPs in total, among them 78 patients with 96 DRPs were cured and 58 patients with 67 DRPs were improved with median of 6.8 days or 27.8 days, respectively. The most common DRPs were drug associated adverse events (68/190) and drug-drug interactions (30/190) among them 3/4 (73/98) could be cured or improved (Figure 3A). Most majority of non-compliance (27/29) could be improved. Judged by experienced clinical pharmacists 38 tumor patients with serious DRPs to which the MMAS–8 was provided from their second time review. At their first time review 24% (9/38) tumor patients displayed medication compliance according to Morisky score (≥ 6), thereafter this rate reached 66% (25/38) at the second time visit, and 84% (32/38), 100% (32/32) at third and fourth time visit, respectively. The improvement on compliance was significant from third time's visit onward with an estimated median of 35 days after second visit (Fisher exact test, $p = 0.0004$) (Figure 3B).

Economic benefit

One patient was diagnosed sigmoid colon cancer with chronic renal dysfunction. The patient's GFR was 40 mL/min/1.73m². This polypharmacy patient was prescribed 21 drugs when he first time visited the MTM clinic. After the negotiation between clinic pharmacists with oncologists and the final drugs list contained 11 essential drugs with equivalent treatment efficacy. This alteration would save ¥157.45 each day (¥4880.95 per month) (Supplement table s2). The data of economic benefit will be discussed elsewhere.

Discussion

It was estimated that greater than 4.2 million new cancer would be diagnosed and 2.8 million cancer deaths would occur in China in 2018 [21]. A non-negligible and long-standing fact is the oncologists are overload in work, which will directly result in shortened time for individual patient and reset the priority in tumor patient management. As a consequence, the treatment efficacy and survival are in high priority, however, the DRPs or other secondary problems in chemotherapy are quite possible marginalized. Polypharmacy and altered metabolic profile in tumor patients would increase the risk of drug-drug interactions, overdose and frequency of adverse drug reactions. On the other hand, the polypharmacy, comorbidity, aging might complicate the situation and contribute to under-prescribing [12, 22, 23]. In a delicate condition or more exactly a dilemma of chemotherapy the oncologists eagerly need the involvement of multi-disciplinary experts especially the role of pharmacists in patients management [24–26].

Fortunately we clinical pharmacists were trained since China's first time introducing the MTM mode from US in 2015 [12, 27–29]. In phase I development we have established the first anti-neoplastic MTM system in Shanghai in 2018 as a result of cooperation of oncologists, clinic pharmacists and software engineers. This MTM workstation also designed to facilitate the communication and cooperation of professionals of different backgrounds, which has been proved to improve patient and physician satisfaction and coordination [30, 31]. This anti-neoplastic MTM can be viewed as an extension of hospital information system, which differs from most prevalent MTM such as in United States of America, or commercial insurance agencies [32, 33]. Up to date the a few MTM systems have concentrated on the medication record development, medication action plan development, patient follow up [34]. We obtained a patent on anti-neoplastic MTM system. However, limited by resources available our clinic can serve patients only for half a day per week, 6–10 patients each time, at present. The ongoing phase II development is more ambitious by incorporating the MTM into the whole medical group system and will collect information through mobile terminal devices.

Five leading tumor types recorded in our anti-neoplastic MTM system were bone, lung, breast, colorectal and prostate cancer. This profile differs from the list of causes of death of China in which the lung, liver, stomach, esophageal and colorectal cancer were the first five diseases. This discrepancy might attribute to the relative advantages of department of orthopedics in our hospital. However, the tumor patients came from more than ten provinces in China. Also a broad geographic distribution will add the difficulty in following up. Our phase II development of MTM system will aim to overcome some known obstacles,

facilitate the communication, integrate deeply into current systems. Also we anticipated an increased MTM clinic visit rate [35], the requirement of growth of pharmacists in dealing with molecular and personalized data [26, 36, 37].

Medication non-adherence would affect health outcomes and overall healthcare cost [28]. In order to improve the patients' adherence, we provided the MMAS-8 for those patients with serious DRPs who were more likely to be frustrated. The adherence score hence provided the clinical pharmacists a direct measurement despite of only 15% (29/190) patients indicated non-adherence. However, the non-adherence in patients might be more common [38, 39], and the involvement of clinical pharmacists would improve patients' adherence [40, 41].

Currently, the sample size and time span are insufficient for a robust inference, the gene related data can not be incorporated into the medication action plan, avenues for communication and patient education have not integrated into MTM system, the MTM workstation has not intervene into the whole process of patient management, still we lack tools to enhance the personalized medication in short term. However, through anti-neoplastic MTM practice the clinical pharmacists are realizing their role in multiple stages of patient management. The pharmacists should be accessible to the general public and professional alike [26] to promote the effectiveness, safety and rational use of medications.

Conclusion

The first anti-neoplastic MTM system in Shanghai was established in Shanghai Jiao Tong University affiliated sixth People's Hospital as a result of multi-disciplinary collaboration. In a year of clinical pharmacists' involvement in tumor patients medication therapy management, seventy percent of DRPs could be resolved (cure or improved) in four weeks; the medication adherence reached 84%–100% following three or four round of review and intervention. Though the sample size and time span limited us from a robust inference, ongoing phase II development was aiming to facilitate the communication, collaboration, deeply intervening into patient management and ultimately to enhance the effectiveness, safety and rational use of medication.

Declarations

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Availability of data and materials

The datasets analyzed during the current study are not publicly available due to privacy reasons, but are available from the corresponding author on reasonable request.

Authors' contributions

JPZ developed the method and performed the evaluation; RX and XCZ conceptualized, collected the data, and wrote the initial draft. YGW: edited the manuscript. WHZ and MSX: analyzed the data; edited the manuscript. HYH, LNT, CG, and ZS contributed to the design of the study, and provided significant feedback. All authors read, revised and approved the final manuscript.

Ethics approval and consent to participate

Informed consent was obtained from all individual participants through signing of informed consent forms. This research was approved by Ethics Committee of Shanghai Sixth People's Hospital (2013-44). Participants were informed of their right to withdraw from the study at their own will without any repercussions at any point during or after the study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no conflict of interest.

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Abbreviations

MTM: medication therapy management; DRPs: drug-related problems; MTR: medication therapy review; PMR: personal medication record; MAP: medication-related action plan; I&R: intervention and/or referral; DFU: documentation and follow-up; MMAS-8: Morisky medication adherence scale; GFR: glomerular filtration rate

References

1. Cancer Today <http://gco.iarc.fr/today/explore>
2. China MTM training <http://cmtm.cmtms.cn/info/cmtm.html>

3. Medication management solutions <https://www.genoahealthcare.com/medication-management-solutions>
4. MMAS-8 <https://morisky.org>
5. Opinions on accelerating the quality development of pharmaceutical services
http://www.gov.cn/xinwen/2018-11/28/content_5344128.htm
6. (1993) Draft statement on pharmaceutical care. ASHP Council on Professional affairs. American Society of Hospital Pharmacists American journal of hospital pharmacy 50: 126-128
7. Andrade SE, Kahler KH, Frech F, Chan KA (2006) Methods for evaluation of medication adherence and persistence using automated databases Pharmacoepidemiology and drug safety 15: 565-574; discussion 575-567
8. Bisharat B, Hafi L, Baron-Epel O, Armaly Z, Bowirrat A (2012) Pharmacist counseling to cardiac patients in Israel prior to discharge from hospital contribute to increasing patient's medication adherence closing gaps and improving outcomes Journal of translational medicine 10: 34
9. Carmona-Bayonas A, Jimenez-Fonseca P, Castanon E, Ramchandani-Vaswani A, Sanchez-Bayona R, Custodio A, Calvo-Temprano D, Virizuela JA (2017) Chronic opioid therapy in long-term cancer survivors Clinical & translational oncology : official publication of the Federation of Spanish Oncology Societies and of the National Cancer Institute of Mexico 19: 236-250
10. Carter SR, Moles R, White L, Chen TF (2015) The impact of patients' perceptions of the listening skills of the pharmacist on their willingness to re-use Home Medicines Reviews: a structural equation model Research in social & administrative pharmacy : RSAP 11: 163-175
11. Chang AR, Evans M, Yule C, Bohn L, Young A, Lewis M, Graboski E, Gerdy B, Ehmann W, Brady J, Lawrence L, Antunes N, Green J, Snyder S, Kirchner HL, Grams M, Perkins R (2016) Using pharmacists to improve risk stratification and management of stage 3A chronic kidney disease: a feasibility study BMC nephrology 17: 168
12. Chen W, Zheng R, Baade PD, Zhang S, Zeng H, Bray F, Jemal A, Yu XQ, He J (2016) Cancer statistics in China, 2015 CA: a cancer journal for clinicians 66: 115-132
13. Cherubini A, Corsonello A, Lattanzio F (2012) Underprescription of beneficial medicines in older people: causes, consequences and prevention Drugs & aging 29: 463-475
14. Dossett LA, Hudson JN, Morris AM, Lee MC, Roetzheim RG, Feters MD, Quinn GP (2017) The primary care provider (PCP)-cancer specialist relationship: A systematic review and mixed-methods meta-synthesis CA: a cancer journal for clinicians 67: 156-169
15. Dunn SP, Birtcher KK, Beavers CJ, Baker WL, Brouse SD, Page RL, 2nd, Bittner V, Walsh MN (2015) The role of the clinical pharmacist in the care of patients with cardiovascular disease Journal of the American College of Cardiology 66: 2129-2139
16. Felton MA, van Londen GJ, Marcum ZA (2016) Medication adherence to oral cancer therapy: The promising role of the pharmacist Journal of oncology pharmacy practice : official publication of the International Society of Oncology Pharmacy Practitioners 22: 378-381

17. Fitzmaurice C, Akinyemiju TF, Al Lami FH, Alam T, Alizadeh-Navaei R, Allen C, Alsharif U, Alvis-Guzman N, Amini E, Anderson BO, Aremu O, Artaman A, Asgedom SW, Assadi R, Atey TM, Avila-Burgos L, Awasthi A, Ba Saleem HO, Barac A, Bennett JR, Bensenor IM, Bhakta N, Brenner H, Cahuana-Hurtado L, Castaneda-Orjuela CA, Catala-Lopez F, Choi JJ, Christopher DJ, Chung SC, Curado MP, Dandona L, Dandona R, das Neves J, Dey S, Dharmaratne SD, Doku DT, Driscoll TR, Dubey M, Ebrahimi H, Edessa D, El-Khatib Z, Endries AY, Fischer F, Force LM, Foreman KJ, Gebrehiwot SW, Gopalani SV, Grosso G, Gupta R, Gyawali B, Hamadeh RR, Hamidi S, Harvey J, Hassen HY, Hay RJ, Hay SI, Heibati B, Hiluf MK, Horita N, Hosgood HD, Ilesanmi OS, Innos K, Islami F, Jakovljevic MB, Johnson SC, Jonas JB, Kasaeian A, Kassa TD, Khader YS, Khan EA, Khan G, Khang YH, Khosravi MH, Khubchandani J, Kopec JA, Kumar GA, Kutz M, Lad DP, Lafranconi A, Lan Q, Legesse Y, Leigh J, Linn S, Lunevicius R, Majeed A, Malekzadeh R, Malta DC, Mantovani LG, McMahon BJ, Meier T, Melaku YA, Melku M, Memiah P, Mendoza W, Meretoja TJ, Mezgebe HB, Miller TR, Mohammed S, Mokdad AH, Moosazadeh M, Moraga P, Mousavi SM, Nangia V, Nguyen CT, Nong VM, Ogbo FA, Olagunju AT, Pa M, Park EK, Patel T, Pereira DM, Pishgar F, Postma MJ, Pourmalek F, Qorbani M, Rafay A, Rawaf S, Rawaf DL, Roshandel G, Safiri S, Salimzadeh H, Sanabria JR, Santric Milicevic MM, Sartorius B, Satpathy M, Sepanlou SG, Shackelford KA, Shaikh MA, Sharif-Alhoseini M, She J, Shin MJ, Shiue I, Shrimme MG, Sinke AH, Sisay M, Sligar A, Sufiyan MB, Sykes BL, Tabares-Seisdedos R, Tessema GA, Topor-Madry R, Tran TT, Tran BX, Ukwaja KN, Vlassov VV, Vollset SE, Weiderpass E, Williams HC, Yimer NB, Yonemoto N, Younis MZ, Murray CJL, Naghavi M (2018) Global, Regional, and National Cancer Incidence, Mortality, Years of Life Lost, Years Lived With Disability, and Disability-Adjusted Life-Years for 29 Cancer Groups, 1990 to 2016: A Systematic Analysis for the Global Burden of Disease Study JAMA oncology 4: 1553-1568
18. Fitzmaurice C, Dicker D, Pain A, Hamavid H, Moradi-Lakeh M, MacIntyre MF, Allen C, Hansen G, Woodbrook R, Wolfe C, Hamadeh RR, Moore A, Werdecker A, Gessner BD, Te Ao B, McMahon B, Karimkhani C, Yu C, Cooke GS, Schwebel DC, Carpenter DO, Pereira DM, Nash D, Kazi DS, De Leo D, Plass D, Ukwaja KN, Thurston GD, Yun Jin K, Simard EP, Mills E, Park EK, Catala-Lopez F, deVeber G, Gotay C, Khan G, Hosgood HD, 3rd, Santos IS, Leasher JL, Singh J, Leigh J, Jonas JB, Sanabria J, Beardsley J, Jacobsen KH, Takahashi K, Franklin RC, Ronfani L, Montico M, Naldi L, Tonelli M, Geleijnse J, Petzold M, Shrimme MG, Younis M, Yonemoto N, Breitborde N, Yip P, Pourmalek F, Lotufo PA, Esteghamati A, Hankey GJ, Ali R, Lunevicius R, Malekzadeh R, Dellavalle R, Weintraub R, Lucas R, Hay R, Rojas-Rueda D, Westerman R, Sepanlou SG, Nolte S, Patten S, Weichenthal S, Abera SF, Fereshtehnejad SM, Shiue I, Driscoll T, Vasankari T, Alsharif U, Rahimi-Movaghar V, Vlassov VV, Marcenes WS, Mekonnen W, Melaku YA, Yano Y, Artaman A, Campos I, MacLachlan J, Mueller U, Kim D, Trillini M, Eshrati B, Williams HC, Shibuya K, Dandona R, Murthy K, Cowie B, Amare AT, Antonio CA, Castaneda-Orjuela C, van Gool CH, Violante F, Oh IH, Deribe K, Soreide K, Knibbs L, Kereselidze M, Green M, Cardenas R, Roy N, Tillmann T, Li Y, Krueger H, Monasta L, Dey S, Sheikhbahaei S, Hafezi-Nejad N, Kumar GA, Sreeramareddy CT, Dandona L, Wang H, Vollset SE, Mokdad A, Salomon JA, Lozano R, Vos T, Forouzanfar M, Lopez A, Murray C, Naghavi M (2015) The Global Burden of Cancer 2013 JAMA oncology 1: 505-527

19. Gerhards NM, Rottenberg S (2018) New tools for old drugs: Functional genetic screens to optimize current chemotherapy Drug resistance updates : reviews and commentaries in antimicrobial and anticancer chemotherapy 36: 30-46
20. Gernant SA, Nguyen MO, Siddiqui S, Schneller M (2018) Use of pharmacy technicians in elements of medication therapy management delivery: A systematic review Research in social & administrative pharmacy : RSAP 14: 883-890
21. Gnjjidic D, Hilmer SN, Blyth FM, Naganathan V, Waite L, Seibel MJ, McLachlan AJ, Cumming RG, Handelsman DJ, Le Couteur DG (2012) Polypharmacy cutoff and outcomes: five or more medicines were used to identify community-dwelling older men at risk of different adverse outcomes Journal of clinical epidemiology 65: 989-995
22. Goh I, Lai O, Chew L (2018) Prevalence and Risk of Polypharmacy Among Elderly Cancer Patients Receiving Chemotherapy in Ambulatory Oncology Setting Current oncology reports 20: 38
23. Guthrie B, Makubate B, Hernandez-Santiago V, Dreischulte T (2015) The rising tide of polypharmacy and drug-drug interactions: population database analysis 1995-2010 BMC medicine 13: 74
24. Hepler CD, Strand LM (1990) Opportunities and responsibilities in pharmaceutical care American journal of hospital pharmacy 47: 533-543
25. Huiskes VJ, Burger DM, van den Ende CH, van den Bemt BJ (2017) Effectiveness of medication review: a systematic review and meta-analysis of randomized controlled trials BMC family practice 18: 5
26. Iuga AO, McGuire MJ (2014) Adherence and health care costs Risk management and healthcare policy 7: 35-44
27. Jokanovic N, Tan EC, van den Bosch D, Kirkpatrick CM, Dooley MJ, Bell JS (2016) Clinical medication review in Australia: A systematic review Research in social & administrative pharmacy : RSAP 12: 384-418
28. Koyama T, Onoue H, Ohshima A, Tanaka Y, Tatebe Y, Zamami Y, Shinomiya K, Kitamura Y (2018) Trends in the medication reviews of community pharmacies in Japan: a nationwide retrospective study International journal of clinical pharmacy 40: 101-108
29. Mensah KB, Oosthuizen F, Bonsu AB (2018) Cancer awareness among community pharmacist: a systematic review BMC cancer 18: 299
30. Mohile SG, Magnuson A (2013) Comprehensive geriatric assessment in oncology Interdisciplinary topics in gerontology 38: 85-103
31. Partridge AH, Avorn J, Wang PS, Winer EP (2002) Adherence to therapy with oral antineoplastic agents Journal of the National Cancer Institute 94: 652-661
32. Puts MT, Costa-Lima B, Monette J, Girre V, Wolfson C, Batist G, Bergman H (2009) Medication problems in older, newly diagnosed cancer patients in Canada: How common are they? A prospective pilot study Drugs & aging 26: 519-536
33. Riechelmann RP, Moreira F, Smaletz O, Saad ED (2005) Potential for drug interactions in hospitalized cancer patients Cancer chemotherapy and pharmacology 56: 286-290

34. Ritchie CS, Kvale E, Fisch MJ (2011) Multimorbidity: an issue of growing importance for oncologists
Journal of oncology practice 7: 371-374

35. Robert J. Cipolle LMS, Peter C. Morley (2012) Pharmaceutical Care Practice: The Patient-Centered Approach to Medication Management. McGraw-Hill Education

36. Shea BJ, Grimshaw JM, Wells GA, Boers M, Andersson N, Hamel C, Porter AC, Tugwell P, Moher D, Bouter LM (2007) Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews BMC medical research methodology 7: 10

37. Simons S, Ringsdorf S, Braun M, Mey UJ, Schwindt PF, Ko YD, Schmidt-Wolf I, Kuhn W, Jaehde U (2011) Enhancing adherence to capecitabine chemotherapy by means of multidisciplinary pharmaceutical care Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer 19: 1009-1018

38. Smith MA, Spiggle S, McConnell B (2017) Strategies for community-based medication management services in value-based health plans Research in social & administrative pharmacy : RSAP 13: 48-62

39. Spivey CA, Qiao Y, Wang J, Shih YT, Wan JY, Dagogo-Jack S, Cushman WC, Hines LE, Chisholm-Burns MA (2019) Comparative Effectiveness of Medication Therapy Management Eligibility Criteria Across Racial/Ethnic Groups Journal of the American Geriatrics Society 67: 581-587

40. Yeoh TT, Tay XY, Si P, Chew L (2015) Drug-related problems in elderly patients with cancer receiving outpatient chemotherapy Journal of geriatric oncology 6: 280-287

41. Zhou M, Wang H, Zeng X, Yin P, Zhu J, Chen W, Li X, Wang L, Wang L, Liu Y, Liu J, Zhang M, Qi J, Yu S, Afshin A, Gakidou E, Glenn S, Krish VS, Miller-Petrie MK, Mountjoy-Venning WC, Mullany EC, Redford SB, Liu H, Naghavi M, Hay SI, Wang L, Murray CJL, Liang X (2019) Mortality, morbidity, and risk factors in China and its provinces, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017 Lancet (London, England)

Table

Table 1. Baseline characteristics of consecutive tumor patients (n=173)

Classification	Items	Patients (%)
Sex (n=173)	female	90(52.0)
Age group, year	≤18	26(15.0)
	19-50	53(30.6)
	51-70	58(33.5)
	>71	36(20.8)
Cancer type (n=173)	Bone	58(33.5)
	Lung	30(17.3)
	Breast	17(9.8)
	colorectal	15(8.7)
	prostate	8(4.6)
	stomach	6(3.5)
	Lymphoma	5(2.9)
	Sarcoma	4(2.4)
Comorbidities (n=217)	Others	30(17.3)
	Hypertension	39(16.6)
	Pain	35(14.9)
	Osteoporosis	30(12.8)
	Immunocompromise	22(9.4)
	Ischemic heart disease	20(8.5)
	Undernutrition	13(5.5)
	Hyperlipidemia	12(5.1)
	Hypohepatia	12(5.1)
	Diabetes mellitus	11(4.7)
	Gastritis	7(3.0)
	Renal insufficiency	6(2.6)
	Bronchitis	5(2.2)
	Hepatitis B	3(1.3)
	Others	20(8.5)
DRPs (n=190)	Adverse drug reaction	68(35.8)
	Potential drug-drug interaction	30(15.8)
	Non-adherence	29(15.3)
	Others	20(10.5)
	Indication without drug	19(10)
	Overdose	8(4.2)
	Underdose	7(3.7)
	Drug without indication	7(3.7)
	Inappropriate drug	2(1.0)
ADRs (n=68)	Constipation	13(16.5)
	Myelosuppression	10(12.7)
	Hypohepatia	8(10.1)
	Rash	8(10.1)

Diarrhea	7(8.9)
Oral mucositis	5(6.3)
Fatigue	5(6.3)
Vomit	4(5.1)
Renal insufficiency	5(6.3)
Hand foot syndrome	5(6.3)
Anorexia	4(5.1)
Nausea	3(3.8)
Proteinuria	1(1.3)
peripheral sensory neuropathy	1(1.3)

Note: the comorbidities and DRPs was counted according to event

Figures

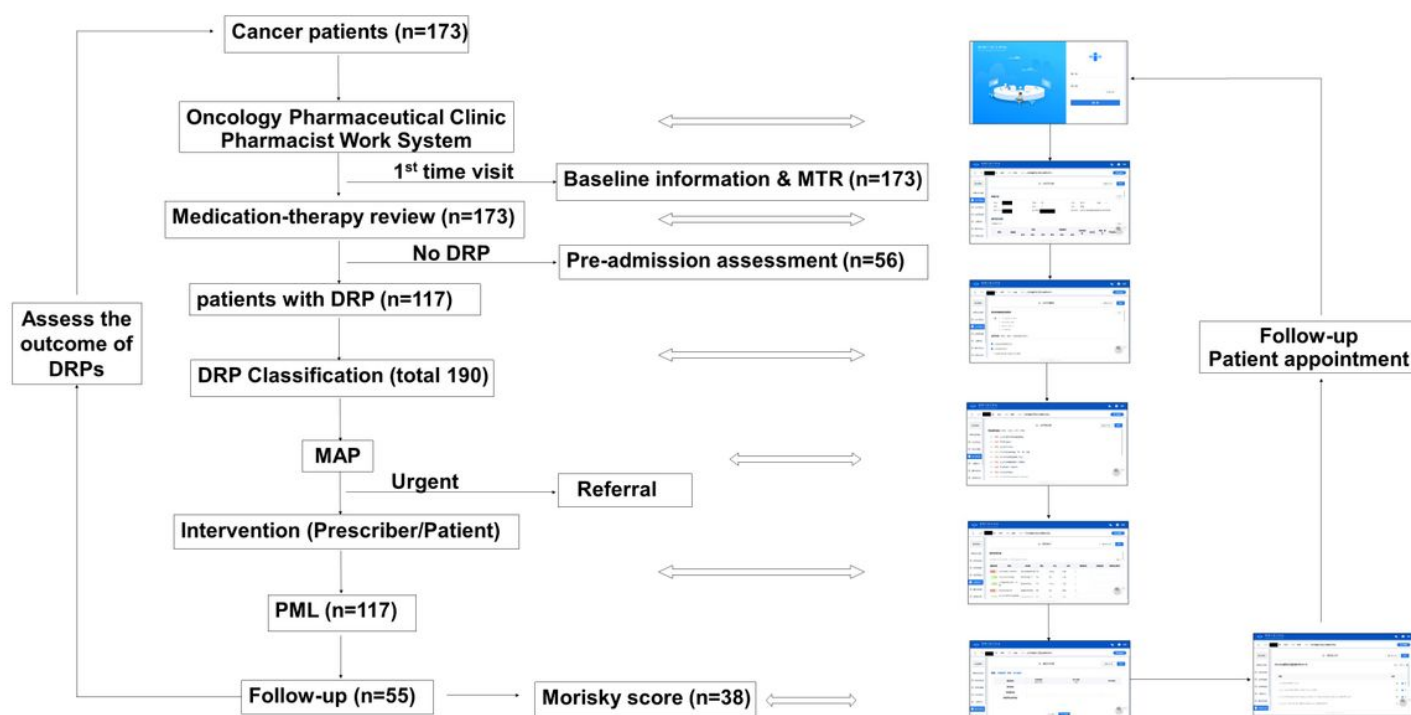


Figure 1

The scheme of patient flowchart in anti-neoplastic medication-therapy management.

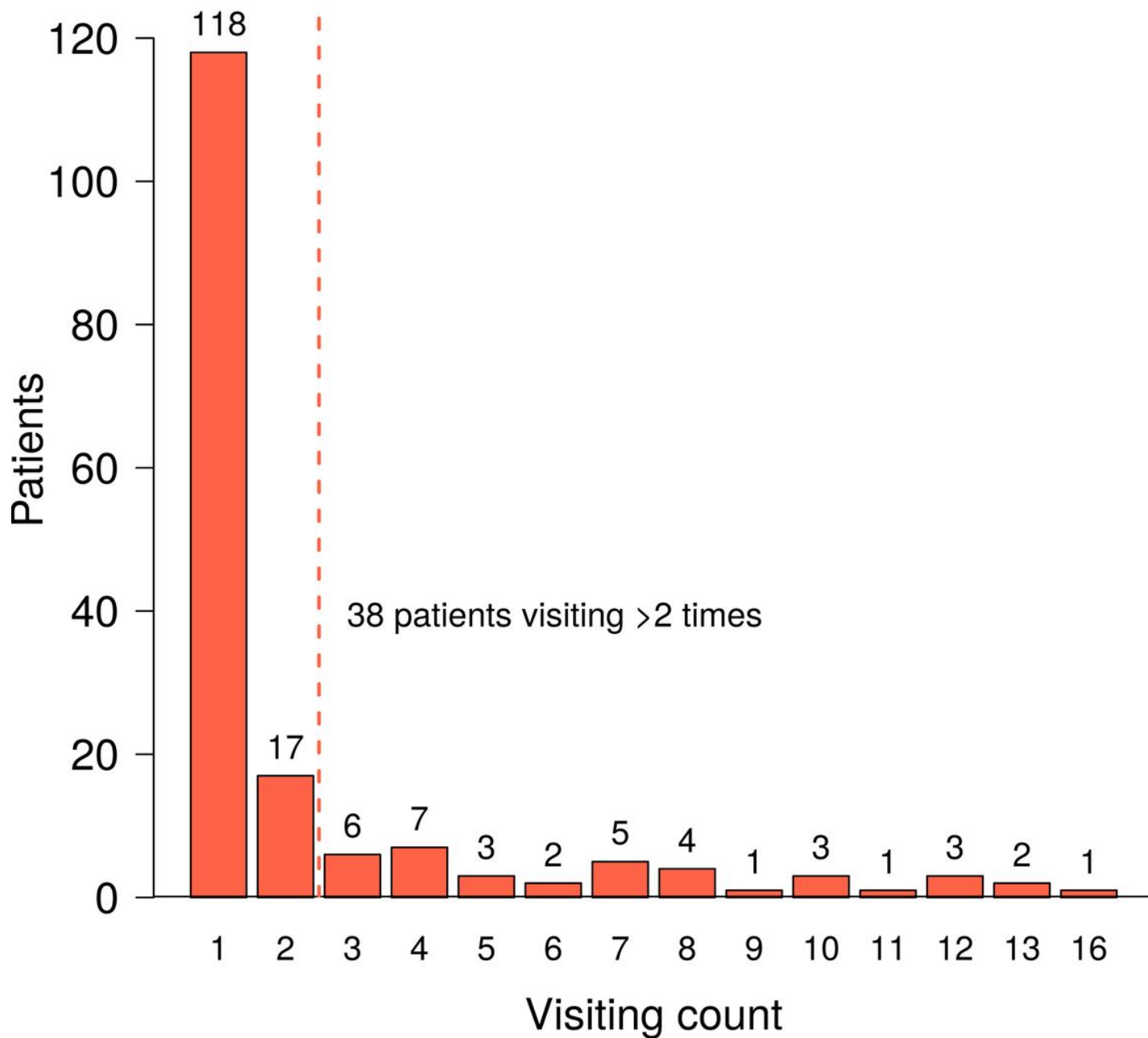


Figure 2

The distribution of patients visiting count. The averaged visiting count of patients was 2.4 times, majority of patients visited once or twice, with 38/173(22%) patients visiting greater than 2 times; a few patients visited greater than ten times within one year (2018-06-06 to 2019-05-31).

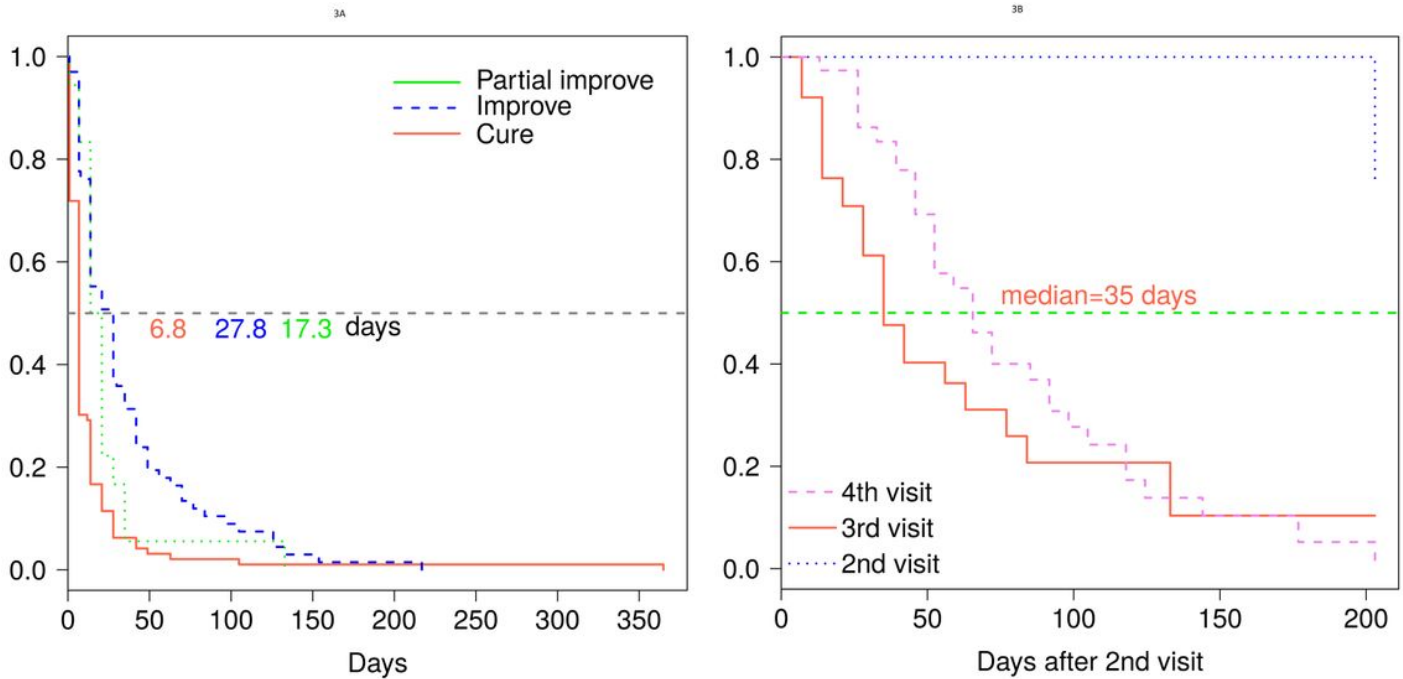


Figure 3

The improvement of patients with DRPs and compliance. (A) 78 patients with 96 DRPs were cured in median 6.8 days, and 58 patients with 67 DRPs were improved in median 27.8 days. (B) by defining the Morisky score ≥ 6 as satisfactory compliance (event=1), the patient compliance was improved significantly since third round visit with a median of 35 days (Fisher exact test, $p=0.0004$).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Supplementmaterials.doc](#)