

ONCOLOGY INFORMATION SYSTEMS

Editor: Professor Ann Jacklin

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A gateway to practical solutions

Ensuring medication safety in anticancer therapy

Cytotoxics preparation: reduction of medication errors and enhancing capacity

Clinical governance focus on issues of technology and chemotherapy e-prescribing

Supporting safe prescribing: automation, pharmacy preparation, back office support

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Oncology information systems: a gateway to practical solutions

Professor Ann Jacklin, MPharmS, CHSM

This educational supplement provides practical solutions to handling issues on medication error reduction, automation, outsourcing and capacity planning.

Cancer is a disease of the elderly and as the population ages, the incidence of cancer will grow. One in three Europeans is diagnosed with cancer and the disease kills one in four people. Every family in Europe is touched in some way by this devastating disease. Cancer is the second most common cause of death after cardiovascular disease. There are more than 2.2 million new cases and more than 1.1 million cancer deaths in the 25 EU Member States (estimated figures for 2006). Every day, more than 6,000 Europeans are diagnosed with cancer and 3,000 die from their disease.

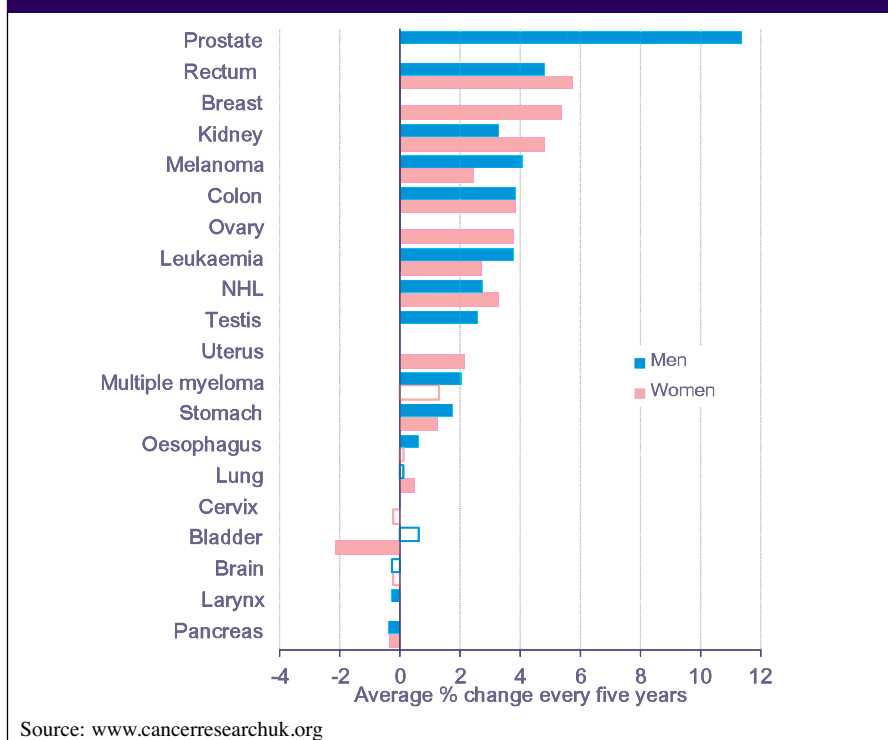
But is it not all bad news. Improvements in screening have led to more cancer being identified. This has been accompanied with an increase in the numbers and types of treatments being available for cancer and more patients are being treated each year with survival rates improving for many cancers, see Figure 1.

In delivering these benefits, healthcare providers have had to deal with growing pressure to improve patient safety and not expose their staff to risk, while at the same time working more efficiently and containing costs.

Hospital pharmacists have a key role to play in reducing the risks associated with chemotherapy treatments throughout the patient pathway from prescribing to compounding to administration.

The risk management of chemotherapy is a particularly challenging area for pharmacists due to a number of factors including:

Figure 1: Average change (%) every five years in 5-year relative survival, by site and sex, adults diagnosed in England and Wales during 1986–99



- High potential for adverse drug events, due to the narrow window between toxic and therapeutic effect and due to the nature of the treatments themselves
- Complexity of dosing and dosing adjustments required
- Significant occupational risk, due to the exposure to toxic drugs during compounding and administration
- High drug costs, due to growing cancer rates and the development of new, expensive drugs
- Pressures to reduce operating costs despite increasing demand.

Electronic health records, automation and oncology information systems can help

reduce many of the risks in part by imposing logical, understandable and repeatable structures on activities. Complete and accurate data can be inputted and received at each process step, improving flow, efficiency and reducing errors.

Hence, it is important that hospital pharmacists keep up to date with not only cancer treatments but also informatics developments. Pharmacists have clinical, compounding, logistics and informatics expertise which, aligned with their commitment to patient safety, mean they are uniquely placed to making a significant contribution to and adding value to optimal patient care.

In this educational supplement, we provide continuing education through the sharing of excellent information on technology development and management experience. By illustrating the experiences of hospital pharmacists with current oncology information systems, we can provide pharmacists and technicians with insight into some practical use and benefits of these systems.

We present a series of articles based on pharmacists' practical experiences, each with the goal of enhancing patient care and reducing medication errors with a particular focus on the background to

and development of oncology information systems and electronic prescribing. We begin with an introductory article that reminds us of many of the drug-related problems that our patients experience and describes a number of ways in which pharmacists can act to ameliorate these problems.

We then broaden our view to not only focus on medication error reduction but also to address issues being faced by our aseptic compounding units needing to increase capacity with diminishing resources. A number of practical solutions are described to address the issues

described, which include the use of oncology information systems, automation, outsourcing and capacity planning.

As Guest Editor, I do hope you will find this series of articles interesting, educational and useful to your practice.

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Ensuring medication safety in anti-cancer therapy

Professor Ulrich Jaehde, PhD

Anticancer drugs require close therapeutic monitoring in order to avoid unnecessary complications, particularly those resulting from polypharmacy. In this article, frequent drug-related problems in cancer patients and measures for their prevention are reviewed.

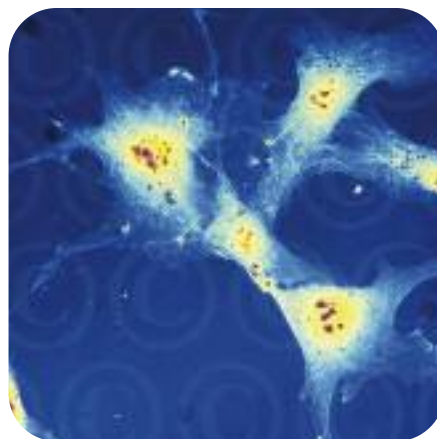
Cancer is not only associated with a high disease burden for the patient but also with complex therapies. The toxicity and narrow therapeutic index of anticancer drugs leads to a high risk of drug-related problems such as adverse effects, under- and over-dosage, interactions with other drugs, and non-adherence. All of these factors can have severe consequences [1]. Moreover, an increasing number of elderly cancer patients are already taking chronic medication at the time of cancer diagnosis. Adding anticancer drugs to their existing medication increases the risk of experiencing drug-related problems still further. The challenge facing healthcare providers is to reduce these treatment-associated risks as much as possible.

Over the last few decades, pharmacists have changed from providing traditional drug-oriented services towards the provision of more patient-oriented services. In oncology, pharmacists have established industry-independent drug information for physicians and patients, and central services for compounding cytotoxic drugs. Together with other healthcare providers, pharmacists have also enhanced efforts to assure quality and safety in systemic cancer therapy. The endeavour to merge and coordinate the individual activities and services of the pharmacist has led to pharmaceutical care concepts which aim to offer novel solutions to various drug-related problems [2].

Drug-related problems in cancer patients

Drug-related problems frequently occur in the treatment path of systemic cancer

therapy. For example, 114 drug-related problems in 58 patients were identified on an oncology ward of a Swedish hospital, indicating their high prevalence in cancer patients [3]. In the following section, four major groups of drug-related problems are briefly reviewed.



Adverse effects

In cancer, chemotherapy adverse effects are intrinsically connected to the treatment itself. Because of the fact that most cytotoxic agents cannot distinguish between normal and neoplastic cells, adverse effects seem to be unavoidable and are often accepted not only by patients but also by healthcare providers. However, most adverse effects are predictable and many are preventable, e.g. by appropriate supportive care or adequate prevention measures [4]. As a consequence, the management of many adverse effects has become possible and increasingly becomes a focus of clinical research.

Under- and over-dosage

Anticancer drugs exhibit a low therapeutic index and a large inter-individual

pharmacokinetic variability. Consequently, the administration of standard doses often leads to under- and over-dosage impeding the clinical outcome of anti-cancer therapy in some patients. Dosing according to body surface area does not solve this problem [5]. Therefore, individually adjusted dosing considering personal characteristics of the patient appears to be crucial for achieving a safe and successful anticancer therapy. The main determining factor for plasma concentrations of drugs is the function of liver and kidneys, since these organs are responsible for metabolism and excretion of exogenous substances. Hepatic and renal functions decrease as people become older, leading to the fact that the fraction of patients with renal or liver dysfunction increases with age.

Drug–drug interactions

Because of widespread polymedication, cancer patients are at particularly high risk of drug–drug interactions that can lead to either enhanced toxicity or a loss of effectiveness [6]. Often, the prescriber has no knowledge of the OTC drugs, and alternative and complementary medication taken by the patient. Regular checks by the pharmacist may solve this problem as he is often the only healthcare provider who oversees the drugs prescribed by various physicians and any self-medication taken by the patient.

Non-adherence

With the increasing importance of orally administrable chemotherapeutic agents and targeted drugs, patients will become more responsible for the correct administration of their prescribed therapy. Thus, adherence issues will play a

bigger role in this therapeutic area. An orally administered therapy can only be effective with an existing high level of adherence. Although cancer patients might be more adherent than other patient groups due to a high level of motivation, the slightest non-adherence can endanger the therapeutic goals. Cancer patients may benefit from interventions towards an optimised adherence resulting in improved outcome. A recent study showed that the adherence of patients to the oral drug capecitabine could be improved by pharmaceutical care. Patients were kept longer on their capecitabine regimen and showed better regularity with regard to drug intake intervals [7]. In general, the development of an adherence monitoring and enhancing infrastructure is a necessary prerequisite to exploit the full potential of orally administrable cancer therapies.

How to assure medication safety

As a first step to a higher level of medication safety, healthcare providers should be well educated and motivated to identify and solve any medication-related problems. The clinically trained pharmacist can contribute by applying his drug-related knowledge and educating patients and other professionals. Although the implementation of clinical pharmacists has already shown positive effects [8], medication safety can only be assured if all healthcare providers adopt a multiprofessional approach. In the following section, four major components of effective multiprofessional interventions are briefly introduced.

Evidence-based guidelines

The development and implementation of evidence-based clinical practice guidelines for supportive care is the key to minimising adverse effects. For example, the introduction of guidelines for antiemetic prophylaxis and therapy has had a positive effect on both clinical and economic outcomes [9]. Guidelines for adverse effect management should also advocate regular checks and dose adaptation strategies for patients with organ dysfunction. For particular drugs such as

fluorouracil, a therapeutic drug monitoring strategy which includes regular plasma concentration measurements can help to reduce toxicity [10].

Patient education and counselling

Patient education and counselling seems to be of particular importance as many cancer patients experience a lack of information during their encounter with care services. Satisfaction with the available information on their treatment appears to be associated with an improved quality of life [11]. Patients who are well informed and know what to expect during the course of therapy are better prepared for how to detect adverse effects and what they can do themselves to minimise them. By playing an active role during treatment, patients can contribute to the prevention of therapy-limiting toxicity.

Medication reconciliation

Since many professions contribute to a patient's holistic care programme, cross-sector cooperation is crucial in order to secure the information flow from one provider to another. The review of the complete medication of each individual patient at the time of transfer, e.g. upon admission or discharge, is often referred to as 'medication reconciliation'. Pharmacists can drive the entire reconciliation process. Alternatively or additionally, medication reconciliation can be integrated within existing information technology, e.g. computerised provider order entry or electronic medical record systems [12]. In Boston, USA, a medication reconciliation programme was designed for ambulatory oncology involving pharmacists and patients as partners in the reconciliation process. Medication errors were reduced by 90% when compared with usual care [13]. Although there are only few data on the clinical outcomes of these programmes, their potential to assure the quality of the medication process is widely recognised.

Task allocation

Multiprofessional work can only be efficient when tasks are clearly assigned to

each individual profession. In a recent study in Germany, 38 tasks regarding cancer medication were identified and assigned to physicians, pharmacists, and nurses. In a nationwide survey, the proposed multiprofessional cancer medication management (MCMM) model was rated to be reasonable and feasible. Such models can serve as a tool to trigger local changes in cancer medication management both on the allocation of necessary tasks as well as their concerted multiprofessional completion [14]. It is important to note that no model fits all settings. Each therapeutic team should find its optimum task allocation depending on the qualification of the available personnel and the specialisation of the oncological centre, clinic, or practice.

Conclusion

Many risks of anticancer drug therapy are preventable by specific measures. The pharmacist's central position with respect to drug dispensing and utilisation can contribute substantially by adding specific drug-related knowledge and offering patient-related services. Efficient communication across professions and sectors is crucial for ensuring medication safety.

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References

1. Jaehde U, Liekweg A, Simons S, Westfeld M. Minimising treatment-associated risks in systemic cancer therapy. *Pharm World Sci.* 2008;30:161-8.
2. Liekweg A, Westfeld M, Jaehde U. From oncology pharmacy to pharmaceutical care: new contributions to multidisciplinary cancer care. *Support Care Cancer.* 2004;12(2):739.
3. Bremberg ER, Hising C, Nylén U, Ehrsson H, Eksborg S. An evaluation of pharmacist contribution to an oncology ward in a Swedish hospital. *J Oncol Pharm Pract.* 2006; 12(2):75-81.

4. Lau PM, Stewart K, Dooley M. The ten most common adverse drug reactions (ADRs) in oncology patients: do they matter to you? *Support Care Cancer*. 2004;12(9):626-33.
5. Gao B, Klumpen HJ, Gurney H. Dose calculation of anticancer drugs. *Expert Opin Drug Metab Toxicol*. 2008;4(10):1307-19.
6. Blower P, de Wit R, Goodin S, Aapro M. Drug-drug interactions in oncology: why are they important and can they be minimized? *Crit Rev Oncol Hematol*. 2005;55(2):117-42.
7. Simons S, Ringsdorf S, Braun M, et al. Enhancing adherence to capecitabine chemotherapy by means of multidisciplinary pharmaceutical care. *Support Care Cancer*. 2011;19(7):1009-18.
8. Viktil KK, Blix HS. The impact of clinical pharmacists on drug-related problems and clinical outcomes. *Basic Clin Pharmacol Toxicol*. 2008;102(3):275-80.
9. Dranitsaris G, Leung P, Warr D. Implementing evidence based antiemetic guidelines in the oncology setting: results of a 4-month prospective intervention study. *Support Care Cancer*. 2001;9(8):611-8.
10. Gamelin E, Delva R, Jacob J, et al. Individual fluorouracil dose adjustment based on pharmacokinetic follow-up compared with conventional dosage: results of a multicenter randomized trial of patients with metastatic colorectal cancer. *J Clin Oncol*. 2008;26(13):2099-105.
11. Annunziata MA, Foladore S, Magri MD, et al. Does the information level of cancer patients correlate with quality of life? A prospective study. *Tumori*. 1998;84(6):619-23.
12. Agency for Health Care Research and Quality. Medication reconciliation. Available from: [psnet.ahrq.gov/primer.aspx? primerID=1](http://psnet.ahrq.gov/primer.aspx?primerID=1) [Accessed 2011 September 13].
13. Weingart SN, Cleary A, Seger A, et al. Medication reconciliation in ambulatory oncology. *Jt Comm J Qual Patient Saf*. 2007;33(12):750-7.
14. Döhler N, Krolop L, Ringsdorf S, et al. Task allocation in cancer medication management - integrating the pharmacist. *Patient Educ Couns*. 2011;83(3):367-74.

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Cytotoxics preparation: reduction of medication errors and enhancing capacity



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An increase in the complexity of chemotherapy over the last ten years has increased pressure on all parts of the chemotherapy service and has increased the potential for error. This article seeks to identify some of these errors and discusses measures to prevent them and ways to address capacity issues.

Over the last 10 years there has been an increase in cancer survival rates, increases in the complexity of regimens including the use of gene therapy and increases in the number of patients being treated in clinical trials. As a result of all of this, there is escalated pressure at all points of the chemotherapy process right through from prescribing to administration of the drugs. This could potentially result in an increased risk of errors occurring at some point in the process. This article seeks to identify some of these risks and discusses ways that Imperial College Healthcare NHS Trust (ICHNT) has tried to address them.

The Trust

Hammersmith Hospitals merged with St Mary's Hospital in 2008 to become Imperial College Healthcare NHS Trust, one of the UK's first Academic Health Science centres. ICHNT provides cancer treatment to around 600 new oncology and haematology patients every year as the cancer centre for the North West London Cancer Network.

Haematology is based at the Hammersmith site, with three 16-bedded inpatient wards, and a large day unit treating lymphoma, acute and chronic leukaemic and myeloma patients. Hammersmith is also a Joint Accreditation Committee-ISCT and EBMT (JACIE) accredited Bone Marrow Transplantation centre.

Oncology patients are treated with chemotherapy on an outpatient basis at all three ICHNT sites: Charing Cross, Hammersmith and St Mary's. There are two 26-bedded oncology inpatient wards at Charing Cross. ICHNT treats all the major solid tumours (breast, colon, rectum, head and neck, neuro-oncology, skin, thyroid, upper GI urological, gynaecological, hepatobiliary) as well as a number of rarer cancers, e.g. gestational trophoblastic disease.



The St Mary's site also provides a shared care paediatric oncology service with Great Ormond Street Hospital and paediatric bone marrow transplants.

We have licensed aseptic units at the Charing Cross and Hammersmith sites that are responsible for the provision of all chemotherapy for the three sites.

Medication errors in chemotherapy

Over 200,000 patients' safety incidents

were reported by National Health Service staff in England and Wales between 2003 and 2008. Of these reports, nearly 5,000 involved anticancer medications [1]. A review of these incidents showed that 23% of incidents occurred during the prescribing process and 26% during the preparation process. However, the main area for harm was during the administration process (43%).

Measures to reduce errors in anticancer medication are therefore essential to reduce the risk of harm to patients. Several other reports in the UK have also highlighted the need for enhanced risk-management in the delivery of anticancer medicine, e.g. *National Confidential Enquiry into Patient Outcomes and Death*, for systemic anticancer treatment mentioned that many of the prescriptions reviewed in the audit were of poor quality with additions and crossings out [2]. Poor communication is also cited as a reason that errors occurred. The National Chemotherapy Advisory Group (NCAG) paper – *Chemotherapy services in England: ensuring quality and safety* [3], clearly recommends that prescription verification and dispensing (of chemotherapy) should only be undertaken by appropriately trained staff.

E-prescribing

The National Cancer Action Team, which is responsible for improving patient experience in the UK, issued the *Manual for Cancer Services – Chemotherapy Measures*. The measures state that all NHS

providers of chemotherapy must use computer-generated prescriptions. ICHNT has this year successfully introduced a new e-prescribing system at the St Mary's site which previously used paper-based prescription pro formas. Although no formal assessment has been undertaken, it is believed that the introduction of the electronic system will reduce prescribing errors, e.g. omitted medication and incorrectly calculated doses. The computer-generated prescriptions also eliminate ambiguity associated with illegible handwriting or hand amendments on the prescriptions. There is an electronic trail of any amendments or interventions made and the facility to include notes and endorsements, often lacking on paper prescriptions.

E-prescribing allows easy access to previous prescriptions and provides information on any previous dose modifications and dates of administration to aid the verification process.

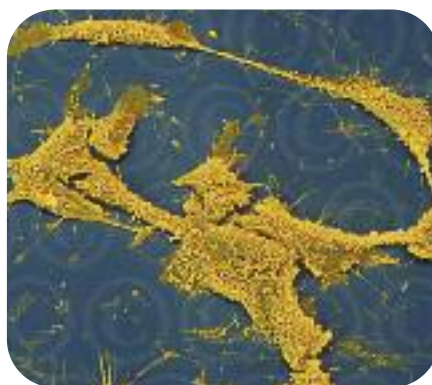
Both dose capping and maximum number of cycles of chemotherapy are programmed into the regimen to ensure there is no overdose and to ensure that chemotherapy is not continued beyond the recommended number of cycles.

However, e-prescribing may introduce other types of errors, e.g. incorrect programming of the regimen onto the system could lead to repeated errors. It is essential that healthcare staff are trained appropriately to avoid unintentional misuse of the system, e.g. amending chemotherapy volumes or incorrectly entering patient data. ICHNT has procedures in place to reduce these risks and a training programme for all staff has been developed. All regimens are built by a chemotherapy-trained pharmacist, then validated by a cancer specialist pharmacist and finally checked and signed off by a consultant. Staff using the system are trained before being issued with a password to use the system and user manuals are easily accessible on the Trust's Intranet. All patient data are checked by both a nurse and a pharmacist.

Currently, ICHNT is introducing a new pathology results reporting system that will interface with the chemotherapy e-prescribing system to eliminate the risk of incorrect manual entry.

Error reporting and management

ICHNT uses the Datix electronic system for incident reporting. Within the cancer services at ICHNT the average incident reporting rate is around four in every 100 admissions for all incidents including medication, the national average is 5.5.



Individual errors are assigned an investigator who is responsible for ensuring all the facts relating to the incident are obtained, e.g. exact nature of error, what measures have been taken/are required to immediately rectify the error, factors that contributed to the error, the outcome and likelihood of the incident recurring. This root-cause analysis is essential to establish that appropriate actions are taken to prevent recurrence.

Once a month, a summary of cancer medication errors is produced and discussed at the Trust's Cancer Clinical Incident Review Committee meeting, which is attended by the cancer pharmacist, the cancer clinical governance lead and senior nurses. Action points on serious errors are fed back to staff and measures implemented to prevent their recurrence. A more detailed quarterly report is also produced and discussed at the Cancer Quality and Safety meeting, where any recommendations are actioned.

Training and accreditation of staff

The NCAG report focussed on training and accreditation of all disciplines that are involved with the prescribing, dispensing and administration of chemotherapy. The British Oncology Pharmacy Association [4] introduced guidelines to assist pharmacists with screening chemotherapy prescriptions and ensures appropriate training of staff [5]. At ICHNT, all pharmacists undergo a training programme which consists of taught work, observing the senior pharmacists, a period of screening 'live' prescriptions which are then second-checked by the senior pharmacist and a log of these items. The trainees are exposed to a wide variety of different regimens and specialities. Once the senior pharmacist is satisfied, the trainee then undertakes a screening test under 'exam' conditions. Only if they have identified all errors can they be accredited to screen chemotherapy and put on the register.

Medical staff and non-medical prescribers must have undertaken local training before being accredited to prescribe chemotherapy. The content of this training includes knowledge of local treatment protocols and specific toxicities associated with the treatment [6]. ICHNT will soon be introducing a computer-based test that requires prescribers to demonstrate their competency. Only consultants, specialist registrars and experienced non-medical prescribers are allowed on to the chemotherapy prescribing register.

Nurses are usually the last check before a patient receives their chemotherapy and so it is essential that they are able to identify any errors that may have gone previously undetected. Nurses must hold an appropriate qualification in chemotherapy and have been assessed as competent to administer chemotherapy by a senior chemotherapy nurse. The content of the training includes the safe administration of chemotherapy and how to deal with the complications of chemotherapy. Accredited nurses are placed on the Trust's Chemotherapy Administration Register.

Intrathecal chemotherapy

In the UK in 2001, after an enquiry into the death of a teenager from the incorrect administration of vincristine, the Department of Health issued guidance on intrathecal chemotherapy (ITC) to ensure this mistake was never repeated. This guidance has since been updated twice, the last in 2008 [7]. The guidance sets strict standards on the procedures involved in the administration of ITC. Key points in the guidance are:

- there should be an Intrathecal Chemotherapy Lead for the Trust
- only trained and accredited staff on the intrathecal register may be involved in the process
- intrathecal chemotherapy must only take place in designated areas.

ICHNT has an Intrathecal Chemotherapy Committee that ensures compliance with the National Guidance. The committee is responsible for maintaining the local Intrathecal Policy and taking action whenever the UK National Guidance is updated, e.g. in 2008, the update included a recommendation that all adult vinca alkaloid doses should be administered in 50 mL mini-bags. There are designated trainers for nurses, doctors and pharmacy staff, to train and accredit staff prior to them being placed on the register. The committee recently completed a risk assessment on its ITC service at the St Mary's site and decided that, as only a small number of ITC procedures were undertaken annually, i.e. fewer than 10, that it was safer not to administer ITC at St Mary's.

Enhancing capacity in cytotoxics preparation/compounding

Advanced prescribing

At ICHNT, we work closely with the prescribers to ensure that prescriptions are generated in a timely manner. The majority of patients can have 2–3 cycles prescribed in advance. There will always be the issue of patient delays and dose modification, but these are easier to accommodate if the majority of chemotherapy is made in advance. Advanced prescriptions can help to ensure that any interventions made by the pharmacists

can be communicated to the prescriber and adjustments made to the prescription prior to the day of treatment. Hastily screened prescriptions can lead to prescribing errors not being identified, or not being rectified in time causing delays for patients.

Outsourcing

One approach to address capacity issues is to look at outsourcing some of the chemotherapy work to commercial manufacturers. Cytotoxics that have relatively long expiries (28 days or more) and are high usage can be considered suitable for outsourcing where cost allows. In some cases, these drugs can be purchased at or around the same cost as vials; these then simply need to be dispensed for individual patients. This approach has been embraced across London and as a result, competitive pricing for a number of chemotherapy agents in ready-to-use forms has been achieved. One of the disadvantages is that nursing staff may have more than one syringe to administer and there has been at least one incident where a patient did not have all the syringes administered and as a result, received a lower dose than that planned.

Additionally, vial prices are rapidly changing, so all outsourced products need regular review to ensure outsourcing is not significantly increasing costs to the healthcare economy.

Vial sharing

At ICHNT we are developing a number of vial sharing schemes where doses of the same drug for a group of patients are made together on a campaign basis. This is more efficient, enables advanced preparation and produces cost savings. We prepare all trastuzumab doses in this way and have recently introduced this approach for bortezomib. In both cases this is delivering significant cost savings to the healthcare economy as well as reducing patient delays. We are now considering the same approach for a variety of other drugs, where cost savings are less marked, as we believe the efficiency gains alone make this worthwhile.

Dose banding

ICHNT has been using dose banding and dose rounding for a number of years. Calculated doses are rounded to the nearest available dose size or combination of syringes within a 5% margin. The doses are then prepared or outsourced products are labelled prior to the patients' treatment date; these can be reissued to other patients if the patients' treatment is cancelled or the doses change. Not only does this lead to less wastage but it can reduce errors in dose calculation.

Automation in aseptics

In 2007, an automated compounding robot was installed in the aseptic unit at the Charing Cross site. We believed the robot would help to address some of the issues around safe handling, risk of repetitive strain in operators as well as delivering cost savings by vial sharing and increasing efficiency. Additionally, the robot uses a combination of bar-code and camera technology to identify the products that are loaded. The robot weighs all products prepared to ensure that the correct dose of chemotherapy has been drawn up. We believe the risk of errors occurring during the compounding process is therefore significantly reduced compared to the manual process.

The robot has enabled us to review the skill mix within the aseptic unit moving towards having more lower-graded staff.

Capacity plans

It is a requirement of our licence that we have capacity plans in place in both aseptic units. Capacity planning is required to ensure that adequate trained staff, equipment and facilities are available to meet workload pressures.

The capacity plan aims to ensure that the:

- Quality of the product and safety of the operator are not compromised
- Staff do not feel under extreme pressure
- Staff do not overwork
- Error rates do not increase.

To ensure that the Aseptic Unit can meet the demands being put upon it, a review of four areas is carried out annually:

- workload
- staffing
- facilities and equipment
- service quality.

A retrospective approach is taken with each area being compared against the previous year's data.

The plan addresses how to deal with short-term problems, e.g. staff sickness, planned shutdown of rooms/equipment; and long-term changes in staffing, facilities and workload. All staff within the aseptic units are aware of the plan and senior staff can invoke it as and when necessary.

Emergency chemotherapy/the need for a 24-hour compounding service

Although the Trust is a large oncology and haematology centre, the pharmacy aseptic units are only open Monday to Friday, 9 am to 5 pm and there is no aseptic compounding service outside these hours. In order to ensure that patient needs can be met we have discussed this with consultants and identified a number of chemotherapy drugs which have been made available as standard doses for emergency use.

Future developments

It is planned that interfaces will be developed between the prescribing systems and the pharmacy systems to prevent double entry of data. This would significantly improve efficiency within our aseptic units.

The same technology that is used within the compounding robot to identify products and check that final doses are correct is being developed so that this will be available to use in clean rooms and isolators. This will prevent the need for a second member of staff to be available to carry out volume checks and should help to reduce errors during manual preparation.

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1. National Patient Safety Agency. A themed review of patient safety incidents involving anti-cancer medicines 1 November 2003–30 June 2008; October 2010.
2. For better, for worse? National confidential enquiry into patient outcome and death. November 2008.
3. Chemotherapy services in England: ensuring quality and safety. A report from the National Chemotherapy Advisory Group. August 2009.
4. Standards for clinical pharmacy verification of prescriptions for cancer medicines. British Oncology Pharmacy Association. January 2010.
5. Guidance to support BOPA standards for clinical pharmacy verification of prescriptions for cancer medicines. British Oncology Pharmacy Association. March 2010.
6. Pan London guidelines for the safe prescribing, handling and administration of systemic anti cancer treatment drugs. April 2011.
7. Health service circular 2008/001: Updated national guidance on the safe administration of intrathecal chemotherapy. August 2008.

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Clinical governance focus on issues of technology and chemotherapy e-prescribing



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This article outlines some of the challenges and benefits that the introduction of electronic prescribing in chemotherapy has had to overcome. The obstacles have been political as well as technical. Now that systems are being rolled out it is clear that a focus on safety must remain if benefits are to be delivered.

The adoption of systems

Reducing the risk of medication related incidents associated with chemotherapy has been a key target for a number of years. A series of deaths related to the incorrect use of intrathecal vinca alkaloids led to the introduction of standards to address the prescribing, preparation and administration of chemotherapy agents [1]. These standards pre-dated the full understanding of the potential benefits that e-prescribing could deliver in relation to chemotherapy errors [2] yet they heralded the beginning of work to look at how to improve the delivery, safety and use of chemotherapy.

The widespread introduction of e-prescribing to support the use of chemotherapy moved up the agenda within health-care following the introduction of the National Programme for IT in 2002. The initial contracts to be delivered as part of the programme required the delivery of chemotherapy e-prescribing systems in 2008–10, however, following a high-profile review of chemotherapy medication use that demonstrated that newer agents were not necessarily being introduced into daily practice in a timely manner this was brought forward to 2006. A *British Medical Journal* editorial published at the time highlighted that the government (via the *Warner Report*) was going to take action to address the lottery of cancer drug use [3]—in particular, the information that e-prescribing systems could provide to feedback prescriber use of agents was identified as a key driver. The information that had to be utilised to generate the data to inform

the report identified that data were not readily available as regards medication use and what could be obtained did not deliver patient or disease specific data.



The *Warner Report* itself outlined the benefits of electronic chemotherapy prescribing relating to both safety and the use of information and supported the deployment of solutions across all cancer networks as part of the national strategic prescribing programme [4]. The benefits identified included:

- demonstrable reduction in the number of prescribing errors
- adoption of common protocols resulting in patients being offered the most appropriate and equitable treatments
- facilitation of both prospective and retrospective audits at all levels
- automation and accuracy of information for reporting to support service delivery
- providing the necessary information for ensuring trusts secure payment for activity
- improved standards of clinical gover-

nance and facilitation of risk management by providing a fully auditable record of all chemotherapy prescribed and administered

- accurate documentation of clinical and pharmacy workload and appointment scheduling to support the achievement of performance targets, e.g. cancer waiting times.

Despite the assertion that systems were to be brought forward as part of the National Programme for IT, this proved to be impossible, as the contracted systems did not have the necessary software available to support roll-out within the time. An alternative approach was therefore adopted in collaboration with Connecting for Health (the agency charged with the delivery of the National Programme for IT) and the Cancer Action Team at the Department of Health. A system specification for the immediate and medium term was drawn up and published [5]. This was utilised to benchmark systems available on the market at the time, identifying that there were alternative solutions available that would support the requirements identified within the Warner report as well as generate data to improve reporting around the use of chemotherapy agents.

Hospital and cancer networks were invited to bid for specific funding to support the procurement and introduction of interim systems to be implemented before the roll-out of the national systems. This led to the implementation of systems which continues to this day.

Currently, approximately 40% of cancer centres have e-prescribing systems whilst others have electronic data collection capturing varying degrees of detail [6]. The recent national cancer strategy again highlights the need for e-prescribing systems and the standardisation of supporting data standards [7] and will continue to drive forward the introduction of systems.

System standards

The development of key information standards to support the consistent recording of the clinical management information on patients undergoing anti-cancer treatment will be a key feature in systems to support reporting as called for in the Warner report [8]. The English standard is currently in draft form being piloted by a number of sites in the UK with the intention of it being adopted formally in 2012. The standard outline notes that 'electronic prescribing systems must contain exact detail of the chemotherapy to be delivered. Although much of the detail may not be required in routine reporting, it is essential for the detail to be recorded consistently for the aggregated data to be accurate.' E-prescribing systems lend themselves well to the agglomeration of this data for audit and research purposes whilst limiting the difference noted to clinicians using the system. This will begin finally to support the Warner report and allow more robust data collection and feedback of practice to clinicians.

Reducing risk

The types of errors that are reported in chemotherapy practice have recently been reported by the National Patient Safety Agency—this highlights the types of errors that systems might be hoped to address [9]. Articles to support the assertion that e-prescribing reduces medication-related errors are now well reported [10] compared to specific publications relating to benefits in chemotherapy reported. General approaches identified in a recent publication on improving medication use and outcomes with clinical decision support systems for chemotherapy [11] include:

- protocol template support—defaulted for daily and therapy doses and weight available for autocalculation; all medicines should be included to avoid omission
- protocol-specific dose alerts
- two nurse signature verification on administration.

Research into the introduction of electronic chemotherapy prescribing has been mainly local and anecdotal, however, this has found that systems offering protocol based electronic chemotherapy prescribing can reduce prescribing error frequency for chemotherapy and supportive care medicines [12, 13]. Benefits have shown a reduction in improper dosing, incorrect dose calculations, cumulative dose calculations and improvements in nurse checklists. These also show that increases in the likelihood of matching medication orders to treatment plans may occur demonstrating that systems are not a panacea for all chemotherapy-related problems.

The introduction of unanticipated errors needs to be borne in mind following the introduction of systems [14]—there is no reason to suppose that chemotherapy prescribing systems will be any different. Recent guidance for the onscreen display of medication-related items includes both general guidance for medication display as well as elements of chemotherapy prescribing outlining where misinterpretation may occur if not appropriately displayed to users [15]. A review of chemotherapy incidents has already highlighted a death associated with e-prescribing following the incorrect set-up of a regimen within the system [9] identifying that the set-up of systems is key to ensuring that errors are not inadvertently introduced.

The challenge for system development and deployment

The challenge for those developing and implementing systems therefore is to translate practice in a manner that reduces medication-related risk whilst supporting improvements in process and reporting. Systems at University Hospital Birmingham were initiated in 2007 when a

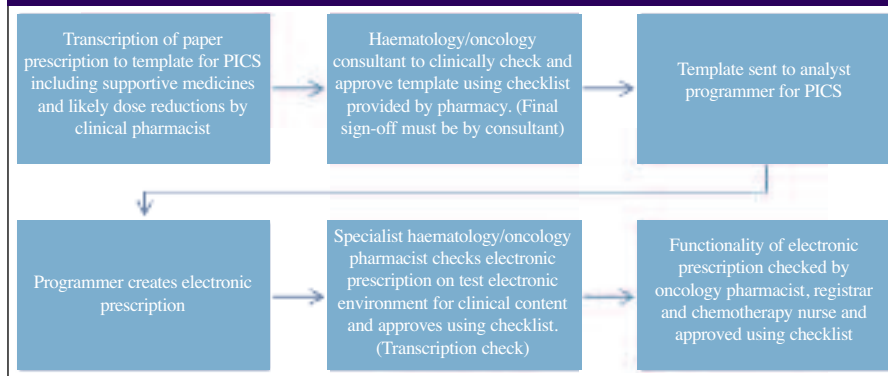
small sample of haematology regimens were programmed into the locally developed system called Prescribing and Information Communication System (PICS) which was already supporting e-prescribing throughout the rest of the hospital.

Electronic templates were devised and completed using the information from the paper regimens by a haematology pharmacist. These were checked by a consultant and then integrated into the e-prescribing system and checked again by a consultant. Functionality testing was then undertaken by a nurse and a consultant. Initially only a small sample of the haematology and oncology regimens was placed onto PICS, leading to the use of a hybrid system; namely paper prescriptions for solid tumour work and electronic for haematology.

Work is now underway to complete the process started in 2007 as the benefits of improved communication and standardisation have become understood. A revised set of governance processes has been put in place following the National Patient Safety Agency (NPSA) report [9] with a review of all the regimens in place leading to an increase in standardisation across the specialties. Changes made to the process have included the removal of a consultant check at each stage, this being replaced by a single consultant sign-off at the point where the paper regimen is transcribed onto the electronic template. Following this the responsibility for the checks lies with specialist haematology and oncology pharmacists with the functionality testing being undertaken by specialist nurses, pharmacists and haematology/oncology doctors. The revised governance process can be seen in Figure 1.

The process may look relatively simple but given the complexity of haematology and oncology prescribing and the specialist areas that they are grouped into, for example, sarcoma, germ cell, small cell lung, it remains complex. Consultant input has been removed from every step and

Figure 1: Governance process overview for adding chemotherapy regimens to e-prescribing system



focused on the initial translation of the paper regimen to electronic. This has focused their attention on the area that has been highlighted by the NPSA as being of particularly high risk [9].

Each element of the overall process has specific checks built-in to ensure consistency of approach and systematic clinical sign-off supporting error minimisation throughout the process. To facilitate this two checklists have been created. The first is to enable the haematology/oncology pharmacists to systematically and repeatedly transcribe the information from the paper regimen to the electronic version. The second aids the haematology/oncology consultants to work through the electronic template and check off that all the information is correct. Specific checks continue through the PICS upload as each addition and amendment is noted on a change log. A functionality testing process is currently being revised to incorporate processes designed to test for known errors associated with chemotherapy prescribing and administration with testing being undertaken by a multidisciplinary group.

The benefits envisaged upon final completion are multifaceted. Not only are there the obvious benefits as outlined earlier regarding reduction in prescribing errors and benefits to patient safety, there is also the added bonus of regimen choice being standardised across the hospital. Also, the additional benefits highlighted by Warner relating to information availability are becoming manifest. Reports relating to

protocol usage and patient outcome are in development to support feedback to clinicians on performance and development of improved practice.

Summary

Chemotherapy can be supported by the introduction of e-prescribing systems. Specific benefits that have been reported include a reduction in medication-related errors, improvements in regimen standardisation and associated reporting on medication use and patient outcome. These benefits do however have to be balanced against the time required to set up systems safely to reduce the risk of introducing new errors into the process—in particular attention must be paid to ensuring that system definitions are adequately tested.

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References

1. National guidance on the safe administration of

chemotherapy. 2001 [cited 2011 July 10]. Available from: www.helapet.com/downloads/nhs%20guidance%20on%20intrathecal%20chemo%20drugs.pdf

2. Bates, et al. Reducing the frequency of errors in medicine using information technology. *J Am Med Inform Assoc.* 2001 July;8(4):299-308.
3. Burke K. UK government moves to tackle lottery of cancer drugs. *BMJ.* 2004 June 19;328(7454): 1453. [Cited 2011 July 10]. Available from: www.bmj.com/content/328/7454/1453.1
4. Implementation of NICE guidance: Lord Warner letter. Department of Health, June 2004 [cited 2011 July 10]. Available from: www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_4083913.pdf
5. Cancer services electronic prescribing system. Functional specification for the immediate/medium term. 2005 [cited 2011 July 10]. Available from: www.connectingforhealth.nhs.uk/systemsandservices/eprescribing/docs/cancer_service_eprescribing_system.pdf
6. Systemic anti-cancer therapy data set advance notification (AN1002). Department of Health. February 2010.
7. Improving outcomes: a strategy for cancer 2011. Department of Health, January 2011. Available from: www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_123394.pdf
8. National cancer intelligence network – systemic anticancer therapy dataset (chemotherapy). [Cited 2011 July 10]. Available from: www.ncin.org.uk/collecting_and_using_data/data_collection/chemotherapy.aspx
9. A themed review of patient safety incidents involving anti-cancer medicines 1 November 2003 – 30 June 2008. National Patient Safety Agency, October 2010 [cited 2011 July 10]. Available from: www.nrls.npsa.nhs.uk/EasySiteWeb/getresource.axd?AssetID=75532&type=full&servicetype=Attachm
10. Ammenworth E, et al. The effect of electronic prescribing on medication errors and adverse drug events: a systematic review. *JAMIA.* 2008;15:585-600.
11. Osheroff. Improving medication use and outcomes with clinical decision support: a step-by-step guide. HIMSS 2009, ISBN: 978-0-9800697-3-0
12. Kim G, et al. Error reduction in pediatric chemotherapy. Computerized order entry and failure modes and effects analysis. *Arch Pediatric Adolesc Med.* 2006;160:495-8.
13. Cheeseman S, et al. The implementation of an electronic prescribing system for chemotherapy and its' impact on the nature and incidence of prescribing errors. BOPA abstract 2005.
14. Ash JS, et al. The unintended consequences of computerized provider order entry: Findings from a mixed methods exploration. *Int. J. Med. Inform.* 2008.
15. Design for Patient Safety. Guidelines for the on-screen display of medication information. National Patient Safety Agency 2010, Edition 1; ISBN 978-1-906624-09-5.

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Supporting safe prescribing: automation, pharmacy preparation, back office support

This article outlines broad principles to be considered when integrating chemotherapy ordering module into practice and focusses on the ability of oncology electronic health records to enhance patient safety through the chemotherapy ordering and administration process, and on standardisation of workflow processes in the practice.

Providing support for the safer prescription of chemotherapy

Significant energy has been directed towards improving the safety of oncology patients through the simplification and standardisation of the chemotherapy ordering and administration process. The administration of antineoplastic agents is a complex process with multiple steps that, upon error, can cause the patient harm. Despite the safety risks, few standards or guidelines for safe administration exist, especially in the outpatient setting [1].

It is unfortunately the case that errors can creep into the process of providing care to the cancer patient. Errors in chemotherapy medication can be due to the use of paper records and manual systems and, even when electronic order entry systems are used, errors are still possible due to human error or due to the system itself [2, 3].

As chemotherapy regimens are commonly customised and ordered on an individual basis, they can be subjected to errors such as those incurred by misreading or misapplying the source material and due to computational errors. Miscommunication of verbal or handwritten orders or assumptions can also lead to errors. The National Comprehensive Cancer Network created a task force to explore the safety issues related to oral chemotherapy and they concluded that safety issues originate from a lack of checks and balances in administration, risk of patient non-compliance, lack of monitoring techniques and a shift to patient management of oral chemotherapy [4].

Electronic health records (EHRs) can reduce many of the risks outlined above

by imposing a logical, understandable, and repeatable structure to the workflow between ordering and receiving a certain prescription [5]. Complete and accurate data can be inputted and received at each step in the process and the many ad hoc steps in everyday practice will be removed and so also contribute to the reduction in errors.



A brief introduction to the value of EHRs

The EHR Workgroup of the American Society of Clinical Oncology (ASCO) has provided an extensive review on how to choose and implement an EHR [6]. These EHRs can increase the efficiency of record keeping and billing, and allow data to be accessed for a number of different purposes and by a number of personnel by replacing the need to keep accurate paper copies of the same information.

An EHR collects patient data and integrates this with information from other sources, thus providing guidance for

real-time clinical decision support. Data from the EHR can also be used for other purposes such as for analysis of practice demographics or reporting on various quality measures.

For the oncologist, EHRs can also include data on tumour staging upon entry of TNM (tumour, node, metastasis), anatomic site, laterality, histology/pathology, biomarkers, chromosomal markers, multidisciplinary workflow documentation, the integration with laboratory and imaging data, chemotherapy ordering and toxicities [5].

Due to the narrow therapeutic index of antineoplastic agents, extreme care must be taken that the appropriate dose is given to the patient. Errors in chemotherapy ordering, preparation and administration therefore have a very high risk of detrimentally affecting the patient.

The majority of principles and policies of clinical practice have been developed and incorporated into systems based on lessons learned from these types of medication errors.

Basic principles of a computerised chemotherapy order entry system

The purpose of a computerised chemotherapy order entry system is to effectively, safely and efficiently order anti-cancer and associated therapies. This system has a high accuracy due to safety features, decision support, and the fact that verbal or handwritten orders are not accepted.

All aspects of the ordering process fall into a set standardisation and include

chemotherapy regimens and associated treatments such as antiemetics. Standardisation is a benefit as it improves the personnel's familiarity with the specifics of order sets, criteria for use and ultimately order safety.

A computerised order entry system includes the automation of calculations, such as body surface area and area under the curve calculations with a built-in set of rounding rules. This has the added benefit of not only reducing possible calculation errors, but also reducing the clinician's workload [7].

Computerised decision support is offered for dose ranges and maximum dose thresholds. These decision support elements can be proposed and approved by an interdisciplinary team of physicians, nurses, and pharmacists.

Inherent flexibility in the system allows for modification as treatments evolve over time. The performance of clinical trials can also be improved by including orders for investigational protocols in the system which can be modified whenever the protocols change.

The workflow integration of the EHR promotes the principle of shared responsibility, redundancy, and the minimisation of ambiguity among the multidisciplinary team. Safety concerns should always take precedence over convenience when determining the workflow.

Examples of workflow rules best practices include:

- Developing a certification process so that only qualified and pre-approved clinicians can order the chemotherapy, with the privileges supported by the EHR system.
- Providing the ability to define user roles with access to individual order set management and restrict access to EHR functionality by user role or department.
- Not allowing infusion room nurses or pharmacists to initiate orders or dose modifications.

- Ensuring that the EHR requires the ordering clinician to enter and/or confirm all important data for the order.
- Requiring the ordering clinician to enter or confirm criteria needed for treatment, i.e. absolute neutrophil count (ANC), creatinine.
- Requiring the ordering clinician to review and confirm all ancillary medications, hydration and chemotherapy orders, and doses after the final doses are calculated.
- Requiring the confirmation of the height and weight previously determined and confirming the creatinine levels (for ANC dosing) when infusion room nurses activate the chemotherapy orders.
- Requiring the agreement of both the infusion room nurse and pharmacist over the prescription of antiemetic drugs, hydration orders, chemotherapy agents, doses and any modifications, and parameters related to the treatment criteria.



Implementing an EHR

In order to implement these principles into your clinical practice, a governance structure must be formalised in order to address the many decisions needed and changes in workflow that will need to take place. In large institutions, committees such as a Pharmacy and Therapeutics

Committee may already be in place; for smaller practices, it may be necessary to create this committee and process.

The committee should be multidisciplinary and should include the oncologists, nurses, nurse practitioners, pharmacists and the administrators who are engaged in the process. The committee should standardise antineoplastic regimens and all ancillary treatments and ensure that all orders are supported by appropriate evidence in the scientific literature. Errors should also be analysed by the committee to optimise the practice's workflow further. A formal system of accountability should also be agreed upon before implementing the EHR.

Usability testing should also be vigorously implemented as this has been found to improve the chances that the EHR design is integrated with the existing workflow and business processes in the most straightforward and efficient way [8].

Standardising anticancer regimens

Standardising the anticancer regimens that patients receive supports accuracy, reduces errors, and enhances workflow by decreasing the ambiguity in treatment options. When creating standard chemotherapy order sets it is recommended that practical issues are taken into consideration [9].

Chemotherapy orders should be entered by regimen rather than by individual drug and then linked to patient diagnosis. This will avoid inter-clinician variability and should be fully supported by the primary scientific literature. Also, regimens should include the default antiemetic choices, standard hydration orders and drugs used to treat hypersensitivity reactions; these should be tailored to the specific chemotherapy and be determined by standard practice guidelines [10].

Chemotherapeutic agents should have dose ceilings, or dose caps, which are the maximum doses that can be ordered using the system. This automatic feature

of the EHR prevents users from entering incorrect requests for potentially lethal doses. The system should be set up so that the user is alerted when an individual dose exceeds the maximum recommended individual dose per regimen entered. This alert could be configured to either give a 'hard stop', that is that the user is not able to override the system, or an alert that can be overridden by the user upon supplying a reason.

Standard dose modification recommendations should be provided in the system as clinical decision support.

When re-ordering a chemotherapy regimen for a subsequent cycle of therapy, the option to reuse a previous order set, including any modifications made to that order, should be present. Investigational protocols should be ordered using the EHR system and should only be available for those patients who are actually registered on that protocol [11].

A documentation audit trail of all orders entered and changes made, including the author's name, time and date is necessary. Regular review of this audit trail data should be performed by the governance committee to identify issues present and to streamline the process further by modifying steps wherever necessary. Once compliance has been maximised, practices should create a mechanism whereby continual periodic surveillance is possible and promoted [1].

Key clinical information (such as pathology reports, diagnostic images, laboratory reports, surgical and procedural notes) should be presented and categorised in a standard manner to improve workflow and safety. An optimal use of outside laboratory reports would be the auto-population of these results into flow sheets in the EHR in order to minimise errors and the inefficiency related to manual entry.

At the centre of an EHR should be the infusions flow sheet. It should be possible to sort the data in this sheet accord-

ing to different fields and should be able to be printed and otherwise exported. Key data should auto-populate this sheet and it can serve as the place where nurses can document what was actually given to the patient, not what was ordered. This is also a good place for other important information, such as any blood transfusions and other supportive medication that has been administered.

Conclusion

Due to the complexity of administrating chemotherapy and the risk of every adverse side effect, standardising the care given in settings where chemotherapy is delivered is essential. The automation of many of the routine practices involved in ordering and prescribing chemotherapy can be handled by EHRs. Compared to paper, the data contained in an EHR can be shared with multiple users at the same time more easily. However, the development and installation of this technology into the clinic must be accompanied by a detailed and careful assessment of workflow.

The first implementation of an EHR into an oncology practice is a very disruptive process, but if the best practices outlined in this article are followed, a safer environment for oncology patients will be created.

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References

- Jacobson JO, Polovich M, McNiff KK, Lefebvre KB, Cummings C, Galioto M, et al. American Society of Clinical Oncology/chemotherapy administration safety standards. *J Clin Oncol*. 2009;27(32):5469-75.
- Bates DW, Gawande AA. Improving safety with information technology. *N Engl J Med*. 2003;348(25):2526-34.
- Voeffray M, Pannatier A, Stupp R, Fucina N, Leyvraz S, Wasserfallen JB. Effect of computerisation on the quality and safety of chemotherapy prescription. *Qual Saf Health Care*. 2006;15(6):418-21.
- Weingart SN, Brown E, Bach PB, Eng K, Johnson SA, Kuzel TM, et al. NCCN task force report: oral chemotherapy. *J Natl Compr Canc Netw*. 2008;6 Suppl 3:S1-14.
- Shulman LN, Miller RS, Ambinder EP, Yu PP, Cox JV. Principles of safe practice using an oncology electronic health record system for chemotherapy ordering, preparation and administration. Part 1 of 2. *J Oncol Pract*. 2008;4(4):203-6.
- ASCO. Oncology electronic health record field guide: selecting and implementing an EHR. Available online: www.asco.org/ehrfieldguide
- DuBeshter B, Walsh CJ, Altobelli K, Loughner J, Angel C. Experience with computerized chemotherapy order entry. *J Oncol Pract*. 2006;2(2):49-52.
- Corrao NJ, Robinson AG, Swiernik MA, Naeim A. Importance of testing for usability when selecting and implementing an electronic health or medical record system. *J Oncol Pract*. 2010;6(3):120-4.
- Shulman LN, Miller RS, Ambinder EP, Yu PP, Cox JV. Principles of safe practice using an oncology electronic health record system for chemotherapy ordering, preparation and administration. Part 2 of 2. *J Oncol Pract*. 2008;4(5):254-7.
- Kris MG, Hesketh PJ, Somerfield MR, Feyer P, Clark-Snow R, Koeller JM, et al. American Society of Clinical Oncology guideline for antiemetics in oncology: Update 2006. *J Clin Oncol*. 2006;24:2932-47.
- Tonks A. Safer by design. *BMJ*. 2008;336(7637):186-8.