Impact Case Study 4 (REF 3b)

Institution: Plymouth University

Unit of Assessment: Unit 3

Title of case study: Dose banding in Chemotherapy: improving patient care and efficiency of services

1. Summary of the impact (indicative maximum 100 words)

This case study summarises the research undertaken by Professor Sewell at Plymouth University in defining and developing the understanding of dose banding, a method for pre-defining standard dose ranges for Chemotherapy. The introduction of dose banding has improved care for patients by reducing the time patients wait for their chemotherapy infusions, enabling prospective quality control of infusions, optimising the infusion preparation process, and reducing wastage resulting in a more efficient, patient focused service for patients. Dose banding is now part of the professional guidelines produced by regional cancer Networks, and is being used in UK hospitals and increasingly across Europe.

2. Underpinning research (indicative maximum 500 words)

In 2008, it was estimated that there are just over two million people living with or beyond cancer in the UK. Incidence continues to rise whilst the death rates fall. This trend is expected to continue and chemotherapy activity continues to increase, yet NHS budgets are under constant pressure.

Chemotherapy doses are calculated by using body surface area (BSA) and prescribed on an outpatient basis; once the patient has been evaluated and test results returned, a bespoke infusion is made up and administered. This is time consuming for the pharmacy compounding unit, involves a lengthy wait for the patient, and the preparation of individual, bespoke infusions precludes quality control (QC) to check infusion sterility, drug identity and concentration. In recent years the validity of traditional individualised dosing algorithms has been questioned and with it the need for exact adherence to the calculated dose.

Research on chemotherapy dosage was begun by Sewell while at Bath and Kingston Universities, latterly also serving as Associate Director of Pharmacy at Plymouth Hospitals Trust. This research was continued with further studies and a survey of prescribers following his move to Plymouth University as Professor in the School of Health Professions in 2009. The research defined the concept of ‘dose banding’ as a system whereby doses of intravenous drugs, calculated on an individualised BSA basis, are fitted to pre-defined dose ranges or ‘dose-bands’, and a standard dose, usually the mid-point of the band, is administered to the patient. The standard dose is provided by using one or more pre-made infusions at previously defined strengths. The dose-bands are designed such that maximum variation between the standard dose and the dose actually prescribed is 5% or less. The pre-made infusions are prepared on a batch scale, and are available for use when the patient enters the clinic, avoiding delays for preparation of bespoke infusions. This approach enables batches of infusions to be QC prior to administration to patients, thus improving patient safety compared to the traditional approach. The early research (Plumridge and Sewell 2001) found that batch preparation is only suitable for infusions with sufficient long-term drug stability.

The take up of dose banding was initially sporadic, despite clear benefits to patients and the healthcare system. In recent years, however, the value of this approach has been recognised in clinical practice. The NCRN OPCS Committee in the UK stated that that although the use of dose-banding in trials was in some ways desirable, there was a need further evidence. In view of these concerns, Sewell (2004-2013) undertook two clinical studies using pharmacokinetic (pk) measures

as surrogates of clinical outcome and toxicity. While at Plymouth University, Sewell (2009) has also carried out a national survey of UK prescribers to further understand the barriers to take up. This found general support for dose-banding but indicated the need for further evidence that the clinical outcome would not be affected.

Sewell (2011) has undertaken further research to establish the stability of infusions of the anticancer agent Vincristine at drug concentrations/storage condition combinations relevant to 'standard' pharmaceutical practice that meet UK Department of Health National Patient Safety Agency guidance. The research found that vincristine infusions were physically and chemically stable for up to 84 days.

3. References to the research (indicative maximum of six references)

Kaestner S and **Sewell G** A survey of UK prescribers opinions on Chemotherapy Dosing and Dose-banding. *Clinical Oncology* 2009, 21, 320-328
Impact Factor 2.072. This is a leading international peer reviewed journal.

Sewell G and Kaestner S. Dose-banding of Cancer Chemotherapy. *Hospital Pharmacy Europe*, (2010) 51, 31-32 Peer-reviewed specialist journal for hospital pharmacy

Trittler, R. **Sewell GJ**. Stability of vincristine (Teva) in original vials after re-use, and in dilute infusions in polyolefin bags and polypropylene syringes. *European Journal of Oncology Pharmacy*, 2011, 5, 10-14. Peer reviewed specialist European journal for its specialism.

G Sewell 14 years of Dose-Banding, Evidence and Experience, invited contribution to Plenary Forum on Dose Banding, European Conference on Oncology Pharmacy (ECOP), Budapest, Hungary, 27-29 Sept 2012.

4. Details of the impact (indicative maximum 750 words)

The introduction of dose banding has improved care for patients by reducing waiting times between authorisation of their prescription and provision of their chemotherapy, reduced pharmacy time in preparation, provided the opportunity for prospective QC, and reduced drug wastage. This has resulted in a safer, more efficient, patient focused service for patients needing chemotherapy. It is being used in the UK and now increasingly across Europe and beyond. In the UK, Cancer Networks bring together the providers and commissioners of cancer care to plan and deliver high quality cancer services. The benefits of dose banding have been recognised by many of the Cancer Networks that have recommended adoption of this approach to Trusts.

Dose banding has been taken up across the UK and is at present being used in over 48 hospitals within the UK (Welsh Cancer Research Networks 2011). The Cancer Network Pharmacists Network produced a toolkit in 2008 to facilitate the introduction of dose banding in England and Wales and which draws upon best practice. The North of England Cancer Network recommends that all Trusts in their region consider introducing a system of standardised dose banding and proposed a scheme to harmonise dose banding across the Network. This is now being taken up across the North of England Trusts. The central South Coast Cancer Network states 'It is our Network policy to dose band many of the chemotherapy agents. Dose banding minimises the number of individual doses that are requires while ensuring that the doses administered are within 5% of the calculated dose. This results in greater efficiency in the preparation and supply of the drugs while minimising wastage'.

Belfast City Hospital has already introduced dose-banded chemotherapy to streamline the dispensing process and minimize patient waiting times. They report the main benefits as being a rapid delivery of chemotherapy, saving approximately two hours in the prescribing process which they see as particularly significant given that the patients are often frail and ill, aseptic

compounding capacity freed up within the department and treatments being completed within the outpatient department opening hours rather than running late.

The All Wales Medicines Strategy Group (2011) has accepted dose banding as a strategy to improve efficiency and reduce cost across Wales. The group has developed an action plan, an interim list of Systematic Anti-cancer Treatments which could be dose banded and has agreed dose bands for them.

Dose banding has been included in software solutions to streamline medical oncology care delivery such as Aria by Varian Medical Systems. ARIA complements clinical judgement with electronic checks and safeguards, including checking for dose limits and dose banding. This software is used across the UK: for example the Central South Coast Cancer Network has implemented it and developed local policies for using dose banding within its six Trusts. It has impacted upon the pharmaceutical industry as well. The Senior Vice-President of Fresenius Kabi, the leading European company for infusion therapy, stated that dose banding has '*tremendously improved efficiencies both in time as well as costs. This has brought very prompt services to customers thereby enabling quicker high quality cancer care*'. He also states that dose banding, as invented by Professor Sewell, has "*increased quality control (and hence patient safety) of chemotherapy infusions and reduced drug wastage*'.

Dose banding is being used outside the UK and has been taken up in France, where it is gaining acceptance through its integration into the National Diploma for Pharmacists and is being used in major French hospitals. The Head Pharmacist at Saint Germain-en-Laye Hospital stated that '*this implementation was very crucial to be able to face the continuous increasing workload for cancer chemotherapy. It gave us a sensible and rational answer to economic pressure and constraints*'. They went onto to say that there has been an uptake of dose-banding at several major hospitals in France and that interest is growing across Europe. They stated that the impact has been '*reduced patient waiting times, control of pharmacy workload, allowing implementation of automation in the process, increased quality control of chemotherapy infusions, reduced drug wastage and giving the possibility for the commercial preparation of standardised chemotherapy infusions*'. Hospital pharmacists use software called 'CHIMIO' for the prescription, preparation and administration of anticancer drugs and the developers have recently included a module for dose banding to support its wide spread use in French hospitals.

5. Sources to corroborate the impact (indicative maximum of 10 references)

This toolkit provides guidance to facilitate the introduction of dose banding by hospitals in England and Wales. Sewell referenced on page 2 as defining dose banding.
http://www.bopawebsite.org/contentimages/publications/Toolkit_Ver_3.0_FINAL.pdf

An NHS project to rationalise the range of products prepared by NHS preparative services. It states that a methodology for dose banding exists in the form of the Dose banding Toolkit and that much of the evidence needed on dose banding is already published from the work of Prof. Graham Sewell.
http://www.medicinesresources.nhs.uk/upload/documents/Communities/SPS_E_SE_England/NAB_Chemotherapy_briefing_InjectablesSymposium_29Sep2010.pdf

Minutes of the All Wales Medicines Strategy Group (2011), where they accept dose banding as a strategy to improve efficiency and reduce cost across Wales.
http://www.wales.nhs.uk/sites3/Documents/371/Draft%20minsAWMSG%20Sept2011final.pdf

President, GERPAC (Group for Evaluation and Research for Protection in Controlled Areas)

and Head Pharmacist Production Unit, Saint Germain-en-Laye Hospital. Factual statement relating to how Sewell invented the concept of dose-banding and the impact in France. It is now part of the Pharmacists national diploma and used in major French hospitals. They state its use is growing across Europe.

Statement from the Senior Vice President of Fresenius Kabi, the leading European company for infusion therapy, transfusion technology and clinical nutrition. The statement highlights the impact Sewell's research has on improving efficiencies in time and cost and enabling quicker high quality cancer care.