Student: Fraser Jeffery
Title: Cost benefit analysis of routine serological titres in reducing re-immunisation in children post-chemotherapy for childhood cancer
Supervisors: Dr Siobhan Cross and Dr Tony Walls
Sponsor: Canterbury Children's Research Trust

Introduction:
Children who are diagnosed with cancer and undergo chemotherapy may lose some or all immune memory gained by routine childhood vaccines. Therefore, child cancer patients are re-immunised following treatment. Depending on the child's age this involves between 12 and 17 separate vaccines and requires monthly GP visits over a period of 6 months.
Prior to 2014, the Children's Haematology Oncology Centre (CHOC) at Christchurch Hospital prescribed a full schedule of vaccines following chemotherapy, assuming all previous immunity was lost. In 2014, a change was made to introduce a serological blood test prior to commencing re-immunisation, matching the policy at Auckland's Starship Hospital. Serological blood tests measure the levels of protective antibodies against an infectious organism in the patient's blood. The purpose of this test is to identify which infectious organisms the patients have retained immunity to, thus eliminating the need to be re-immunised for those organisms.
However, there is controversy in the literature regarding the value of serological testing prior to re-immunisation. Potential advantages are a reduction in the number of injections given to children and a reduction in cost of revaccination. Disadvantages may include the addition of an extra blood test for the child, added cost of the serological testing and delay in starting revaccination. There is no harm in receiving a vaccine you already have immunity to.

Aim:
To determine if routine serological testing at 4-6 months post chemotherapy treatment reduces the number of vaccinations required by children.
If serological testing reduces the number of vaccinations required does this result in an overall cost saving taking into account the upfront costs of serological testing.
Audit the compliance with the national immunisation policy.
Document the relationship between immunisation history pre-cancer diagnosis, serological testing at diagnosis and 4-6 months post treatment.

Impact:
This study will guide whether CHOC and Starship will continue to perform serological testing on patients, prior to revaccination.

Method:
The study population was identified from those who finished chemotherapy treatment over a two year period between 2014 and 2016.
Results of serological testing 4-6 months after treatment were obtained and any subsequent reduction in the number of vaccinations was determined.
The total cost of serological testing was determined from Canterbury Health Laboratories costings in 2014. The value of the total number of vaccination vials saved was determined using costs from Ministry of Health and PHARMAC estimates. The costs of GP visits were not included in the analysis.
Immunisation records were obtained from the National Immunisation Register, GP records and records kept by CHOC. These were used to assess compliance with the national immunisation policy.

Results:
85 patients were identified based on their end of treatment dates, 23 were excluded as per the study's exclusion criteria.

69% of the study population avoided at least one vaccination as a result of serological testing. The average number of vaccinations avoided per patient was 2. This reduced the average number of vaccinations prescribed per patient from 14 to 12. With the addition of the serology blood test, the average number of needle sticks was reduced from 14 to 13 per patient. The most common vaccine avoided was varicella zoster virus (also known as chicken pox) with 65% of patients avoiding it. Only 18% of children were able to avoid the MMR vaccine and only 11% avoided vaccines combining diphtheria, tetanus and hepatitis B.
The estimated cost of serology testing was $18,318 per 100 patients. The estimated cost saving from the results of the tests was $7,884 per 100 patients.
The compliance audit found that 68% of patients had received all vaccinations prescribed or were up to date with revaccination. 51% of patients received all their vaccinations on time according to the immunisation schedule.
Comparing the patients before and after chemotherapy treatment, hepatitis B immunity decreased (39% to 16%) as did measles immunity (78% to 48%). Varicella immunity was more stable with 71% immune before and 67% immune after treatment.

Conclusion:
The results of this study show that serological testing provided only a small reduction in the number of needle-sticks. Also, the cost saving from the reduction in the number of vaccines given did not offset the upfront cost of the test, resulting in an overall increased cost to the health system. Compliance with immunisation policy was generally good but could be improved.
Because of this study, CHOC may move to stop serological testing or may target fewer tests to be more cost effective. One option may be to only test for varicella zoster immunity as the majority of patients were immune and avoided the vaccine. There seems less value in testing for immunity to infectious organisms in multi-valent vaccines as one must be immune to all the organisms in the vaccine to avoid it, shown by low rates of avoidance to vaccines such as MMR.
The results of this study will likely be combined with Auckland data to achieve a larger patient group for publication.