Erasmus School of Health Policy & Management

Convergence

Founding Partners

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Cost-Utility Analysis of Village in a Dish Technology for Predicting Carboplatin Plus Paclitaxel-Induced Side Effects in Cancer Care

Introduction

- Globally billions are spent on treating chemotherapy-induced serious adverse events (SAEs) and they significantly reduce QALYs.
- Comprehensive genetic testing to predict chemotherapy-induced SAEs is not yet standard practice.
- The widely used chemotherapy carboplatin-paclitaxel (CarboTaxol) frequently causes haematological SAEs.
- Village in a dish technology (ViaD) is a novel platform that can predict the risk of haematological SAEs from CarboTaxol by genetically analyzing many patients' cells in a single test (Figure 1).

Objective

- To assess the early cost-utility of the ViaD test, which can identify high-risk patients for primary prophylaxis, compared with standard care, where side effects are treated only after they occur.

Methodology

- Literature review and exploration of gene expression atlas to determine feasibility of ViaD.
- Literature review to find input parameters (Table 1).
- Decision tree to represent the potential set of outcomes under ViaD guided care vs standard of care (Figure 2a), and under 80% accuracy of the test (Figure2b).
- Cost-utility analysis to evaluate the potential economic impact and health gain of ViaD.
- Sensitivity analysis on ViaD accuracy to determine change in incremental cost effectiveness ratio (ICER).

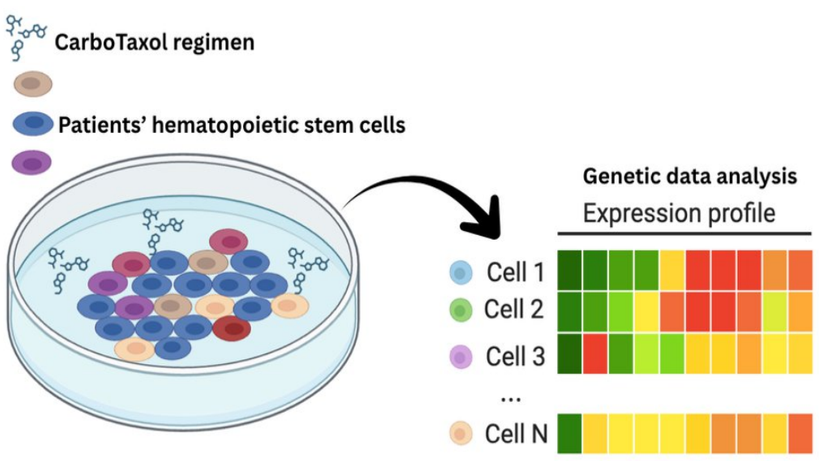


Figure1: ViaD allows incubation of patients' cells with CarboTaxol followed by genetic analysis to determine individual risk.

Figure 2a: Decision tree illustrating the likely outcomes of ViaD test compared to standard care.

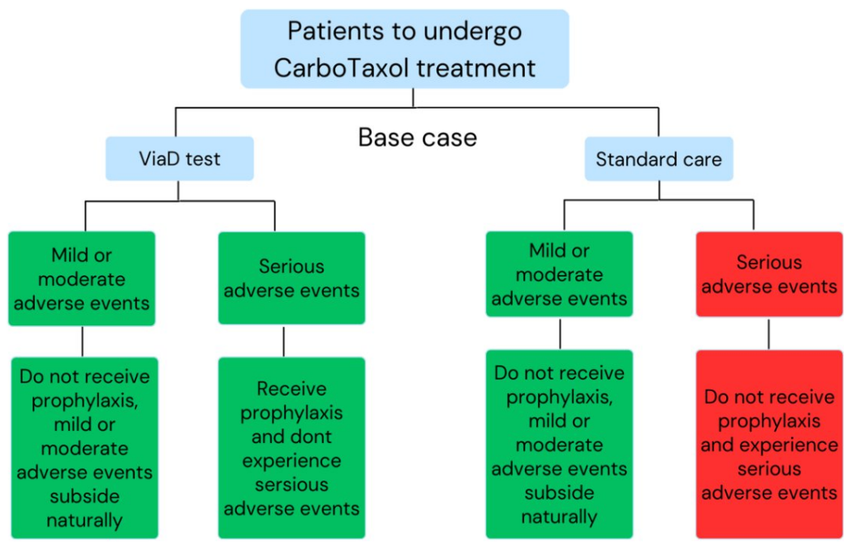
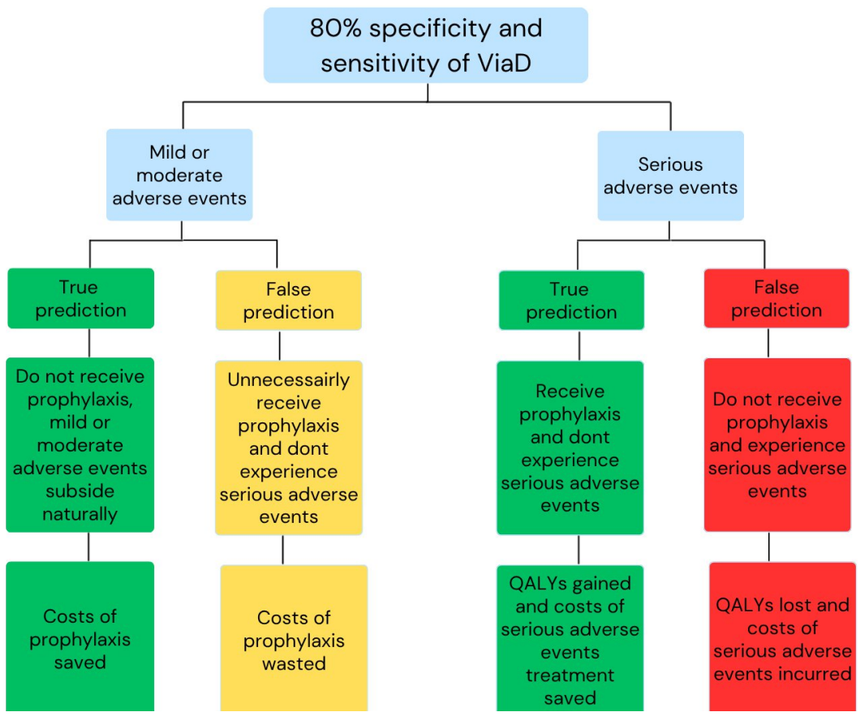


Figure 2b: Decision tree illustrating the likely outcomes of ViaD test under 80% specificity and sensitivity.



Results

The standard care for managing severe hematological adverse events caused by CarboTaxol across various cancer types costs an average of €2,490 per patient. In the base-case analysis (assuming a ViaD test cost of €1,000 and 100% accuracy), the ViaD test strategy costs €2,891 per patient and leads to a 0.010 QALY gain. This results in an ICER of €40,100 per QALY gained for the ViaD test strategy. Under 80% sensitivity and specificity, the total costs of ViaD strategy rose sharply and also decreased 0.002 QALY (compared to base-case) as false negative patients will miss prophylaxis and experience ASEs and incur costs of ASEs management. Moreover, the false positive patients will unnecessarily receive prophylaxis, leading to additional costs.

Table 2: The table highlights the impact of variations on ViaD test cost and accuracy on ICER.

Scenario	Cost of ViaD Test (€)	Total Costs ViaD strategy (€)	ICER (€ per QALY)
Lower Test Cost	800	2691	20100
Base Test Cost	1000	2891	40100 (basecase)
Higher Test Cost	1200	3091	60100
80% sensitivity and specificity of Viad	1000	3267	97125

Table 1: The table highlights literature driven parameters. Given the significant variability in the literature-reported duration of leukocytopenia, a standard duration of 11 days was adopted for this model, which is a typical period required for myeloblastic cells to regenerate leukocytes. Due to lack of available data on effectiveness of RBC transfusion, the model is built under assumption of 100% effectiveness of this prophylaxis.

Probabilities	**Base Value**	**Unit**	**Durations**	**Base Value**	**Unit**
Leukocytopenia risk	33	%	Leukocytopenia	0.030	Year
Neutropenia risk	67	%	Neutropenia	0.200	Year
Febrile neutropenia risk	4	%	Febrile neutropenia	0.178	Year
Thrombocytopenia	12	%	Thrombocytopenia	0.125	Year
Anemia	8	%	Anemia	0.028	Year
Costs (€)	Base Value	Unit	**Prophylaxis Effectiveness (%)**	**Base Value**	**Unit**
Leukocytopenia management	1719	€	G-CSF (Leukopenia/Neutropenia/ Febrile Neutropenia)	67.6	%
Neutropenia management	1621	€	Platelet transfusion (1U) (Thrombocytopenia)	7	%
Febrile neutropenia management	3559	€	RBC transfusion (2U) (Anemia)	100	%
Thrombocytopenia management	4271	€	**Disutilities**	**Base Value**	**Unit**
Anemia management	2272	€	Leukocytopenia	0.15	Per case
Prophylaxis (G-CSF 10mg Pegfilgrastim)	653	€	Neutropenia	0.09	Per case
Prophylaxis Platelet transfusion (1U)	753	€	Febrile neutropenia	0.15	Per case
Prophylaxis RBC transfusion (2U)	787	€	Thrombocytopenia	0.11	Per case
ViaD test	1000	€	Anemia	0.09	Per case

Conclusion

This cost-utility analysis indicated that ViaD (base-case) yields an additional 0.010 QALYs at an incremental cost of €401 compared with standard care, which lacks SAE risk testing. Therefore, ViaD strategy is cost-effective under the €80,000/QALY threshold in the Netherlands. The model concentrated on short-term hematological toxicities associated with CarboTaxol across multiple cancer types, as these effects are driven primarily by drugs toxicities rather than the malignancy itself. Long-term outcomes and societal costs were not included, given their variability across cancer types.

There are several limitations to consider. For instance, ViaD may not capture all underlying mechanisms of hematological SAEs, as some are too complex to be accurately modeled by the test. In addition, prophylaxis can cause side effects too that were not accounted for in this study, which could increase the ICER. Conversely, patients who experience cancer recurrence would not require repeat ViaD testing, potentially reducing the ICER in recurrent disease scenarios. Lastly, these parameters reflect the costs in the Netherlands and may generate higher or lower ICER in other countries.

These findings highlight the need for future clinical trials to validate the cost-effectiveness of ViaD in predicting CarboTaxol-induced SAEs.

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