Nature of Science (NOS) and Common Core Mathematics Practice (CCMP) Analysis

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The article that I am choosing to analyze is 'Lung Cancer Patients Live Longer With Immune Therapy' by Denise Grady, published in the New York Times on April 16, 2018 (Grady, 2018). I have a personal connection to this article as my mother-in-law has recently been battling lung cancer and has responded positively to immune therapy. I am hopeful that what was once a terminal prognosis for many can in the future be a curable disease thanks to the advances in this area.

This article does an excellent job at conveying to the reader the findings of a major study supporting treatment of lung cancer with immune therapy. The middle portion of the article describes the key findings from a study by Dr Leena Ghandi (Ghandi, 2018): its sample size (616 patients), the ratio of treatment versus placebo that was given to patients and the median survival rates of the treatment group versus the placebo group. The article summarized the impact of lung cancer on the US population, which allows the reader to infer the possible scale of the benefits of immune therapy. This portion of the article aligns well with the Understandings about the Nature of Science as stated in NGSS (NGSS Lead States, 2013). The author conveyed that the study followed established protocols for testing of pharmaceuticals. The data was analyzed and logical connections were made to suggest that the treatment has positive effects. Finally, the article stated that other organizations testing for the effectiveness of immune therapy treatments had shown positive results, implying that a variety of methods and tools had been used to support this scientific discovery.

Grady completely avoids the use of 'dead words' (Schwartz, 2007) such as 'prove' or 'truth' in her article. She does use the less direct term 'shown' when describing the impact of immune therapy on lung cancer: 'Odds of survival can greatly improve for people with the most common type of lung cancer if they are given a new drug that activates the immune system along with chemotherapy, a major new study has *shown*.' While 'shown' is not as strong as 'prove', the former term could be interpreted by a reader to mean the same thing. The article also quotes a researcher as saying that 'Immunotherapy has the ability to cure' and follows this quote with a statement from the researcher that 'we have had patients on these immunotherapies alive more than eight years.' This quote is too juicy for the writer to avoid including in their article, even though this is an example of someone inferring a pattern based on possibly weak evidence (Schwartz, 2007).

Mathematics is used throughout this article to help the viewer understand both the methodology of the study as well as its impact on lung cancer patients. Attention to precision (NGA Center/CCSSO, 2018) was attempted throughout the article to enable fair analysis of the data by the reader. Most important values (such as survival rates) are given to 3 significant figures. Closer inspection of the original article (Ghandi, 2018) shows that it included confidence intervals for survival data. For example: Grady's article quoted the survival rate for immune therapy treated patients as 69.2% after 10.5 months, while placebo treated patients had a survival rate of 49.4% after 10.5 months. The confidence interval in the original article for the immune therapy treated patients was from 64.1% to 73.8% and for the placebo treated patients it was from 42.1% to 56.2%. Grady's use of the 69.2% versus 49.4% values looks a lot better than the possible 64.1% (low value immune therapy) vs 56.2% (high value placebo). The article should have included these confidence intervals to give more precision to its values.

The article does a good job using mathematics to construct a viable argument (NGA Center/CCSSO, 2018) that supports its title. The article includes all major findings from the study and statistical analysis of the data is used to support the claim that immunotherapy performs better than pre-existing treatments for lung cancer. The use of the term 'median' is significant in making a convincing case to the reader. The statistical analysis in this article could be used to support student learning of Statistics and Probability (6-8.SP) (NGSS Lead States, 2013). Additionally, comparison of immune therapy treated patients with placebo treated patients could be used to support student learning of Ratios and Proportional Relationships (6-7.RP) (NGSS Lead States, 2013). Students can be challenged to chart the ratio of survival between the two groups over time and answer the question if the difference is significant enough to warrant further investigation.

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