**Appendix 2**

**Path Analysis**

Why a path analysis?

Given the group’s research question and the bivariate relationships of interest that emerged from the first round of analysis, it became quite clear that we were theorizing a more detailed sequence of effects. Path analysis allows us to examine this sequence of effects by testing a theory of causal order among a set of variables(1). Essentially, instead of focussing on one specific relationship or set of effects on a single dependent variable, path analysis allows us to test the entire set of proposed interrelationships. In other words, it examines whether one variable influences another which in turn influences a third variable (2).

The following diagram displays the sequence of effects we tested:



Note: Hypothesized causal relationships are represented by single-headed, unidirectional arrows, while hypothesized non-causal correlations between variables are represented by double-headed arrows.

In order to execute this path analysis, a decomposition of the total effects was performed for the model. This process involved calculating the indirect and direct effects through a systematic application of ordinary least squares (OLS) regression. The total effect of one variable on another is comprised of indirect effects, which are effects that are mediated by intervening variables; and direct effects, which are unmediated influences of one variable on another. In this model, the indirect effects are decomposed so that physician productivity is the only intervening variable.

As mentioned above, the decision to examine this particular model is based on a logically sound breakdown of the causal ordering of effects. It is hypothesized that factors external to the emergency department, such as physician characteristics (including the training program they completed, their age) influence physician productivity as well as patients directly. Similarly, patient characteristics such as patients’ age and the percentage of patients who need to be admitted (also outside the control of the emergency department) are hypothesized to influence physician productivity (i.e., physicians who treat older patients who often have to be admitted to hospital could see an effect on their productivity). In addition to influencing productivity, these patient characteristics likely also influence patient experience (captured by the composite items). The pathway of most interest, however, hypothesizes that physician productivity has an effect on measures of patient experience.

So why decompose the effect and expand the model? Essentially, we are attempting to explain the mechanism by which certain variables contribute to emergency department patient experience.

The following table displays the decomposition of effects of physician characteristics and patient characteristics on physician productivity:

|  |
| --- |
| **Decomposition of the total effects of physician characteristics and patient characteristics on physician productivity** |
| **Outcome variable** | **Pre-determined variable** | **Total effect** | **Indirect effects** | **Direct effect** |
| *Variable* | *Element* |
| Physician productivity | Admitted patients | Percentage of patients admitted | -0.007 |   | -0.007 |
| Patients' age | Average age of physicians' patients | -0.117 |   | -0.117 |
| Physician training program | *Base case: CCFP-EM 1* |
| FRCPC2 | -0.040 |   | -0.040 |
| Physician age | Age in 2012 | 0.030 |   | 0.030 |
| \* = p ≤ 0.05 ; 1=Canadian College of Family Physicians- Emergency Medicine; 2=Fellow of The Royal College of Physicians of Canada)  |
|  |

Notes:

* There are no indirect effects in this table because all of the physician and patient characteristics are hypothesized to directly influence physician productivity, without being transmitted through mediating variables.
* The values displayed in this table (and the table to follow) represent standardized coefficients. Therefore, care should be taken when interpreting the results. We recommend the reader use the information to ascertain strengths and directional effects, especially given the difficulty of interpreting standardized dichotomous values.

Results from this table reinforce the findings of our bivariate analysis of the data, and indicate that male emergency physicians tend to be more productive than female emergency physicians. However, aside from the effect of gender on physician productivity, effects appear to be quite weak.

Results for the next step of the path analysis, the decomposition of effects of physician characteristics (including productivity) and patient characteristics on measures of patient experience, are displayed in the table below.

|  |
| --- |
| **Decomposition of the total effects of physician characteristics (including productivity) and patient characteristics on patient experience ratings** |
| **Outcome variable** | **Pre-determined variable** | **Total effect** | **Indirect effects** | **Direct effect** |
| *Variable* | *Element* | *Via average productivity* |
| Staff care and communication | Admitted patients | Percentage of patients admitted | -0.013 | 0.001 | -0.014 |
| Patients' age | Average age of physicians' patients | -0.013 | 0.007 | -0.020 |
| Physician training program | *Base case: CCFP-EM* |
| FRCPC | -0.104 | 0.003 | -0.107 |
| Physician age | Age in 2012 | -0.025 | -0.002 | -0.023 |
| Physician productivity | Average productivity | -0.061 |   | -0.061 |
| Pain management | Admitted patients | Percentage of patients admitted | 0.050 | -0.001 | 0.051 |
| Patients' age | Average age of physicians' patients | 0.022 | -0.005 | 0.027 |
| Physician training program | *Base case: CCFP-EM* |
| FRCPC | -0.004 | -0.001 | -0.003 |
| Physician age | Age in 2012 | -0.158 | 0.001 | -0.159 |
| Physician productivity | Average productivity | 0.041 |   | 0.041 |
| Discharge communication | Admitted patients | Percentage of patients admitted | 0.165 | 0.001 | 0.164 |
| Patients' age | Average age of physicians' patients | -0.111 | 0.016 | -0.127 |
| Physician training program | *Base case: CCFP-EM* |
| FRCPC | -0.078 | 0.006 | -0.084 |
| Physician age | Age in 2012 | -0.005 | -0.004 | -0.001 |
| Physician productivity | Average productivity | -0.136 |   | -0.136 |
| Respect | Admitted patients | Percentage of patients admitted | -0.033 | 0 | -0.033 |
| Patients' age | Average age of physicians' patients | 0.094 | 0.002 | 0.092 |
| Physician training program | *Base case: CCFP-EM* |
| FRCPC | 0.169 | 0.001 | 0.168 |
| Physician age | Age in 2012 | 0.015 | -0.001 | 0.016 |
| Physician productivity | Average productivity | -0.018 |   | -0.018 |
| Medication communication | Admitted patients | Percentage of patients admitted | 0.188\* | 0 | 0.188\* |
| Patients' age | Average age of physicians' patients | -0.149 | -0.002 | -0.147 |
| Physician training program | *Base case: CCFP-EM* |
| FRCPC | -0.023 | -0.001 | -0.022 |
| Physician age | Age in 2012 | -0.106 | 0.001 | -0.107 |
| Physician productivity | Average productivity | 0.023 |   | 0.023 |
| Wait time and crowding | Admitted patients | Percentage of patients admitted | 0.214\* | 0.001 | 0.213\* |
| Patients' age | Average age of physicians' patients | 0.062 | 0.009 | 0.053 |
| Physician training program | *Base case: CCFP-EM* |
| FRCPC | -0.093 | 0.003 | -0.096 |
| Physician age | Age in 2012 | -0.109 | -0.003 | -0.106 |
| Physician productivity | Average productivity | -0.076 |   | -0.076 |
| \* = p ≤ 0.05 |

These results again reconfirm the findings from our bivariate analysis, and indicate that emergency department patient experience ratings regarding Medication Communication’ and ‘Wait Time and Crowding’ improve when a higher percentage of patients are admitted. Although these two pathways were significant, it is important to note that the indirect effects via physician productivity are extremely small (0 for ‘Medication Communication’ and 0.001 for ‘Wait Time and Crowding’), suggesting that the indirect paths through productivity likely do not contribute to these relationships. Therefore, overall we conclude that we could not find evidence to support the hypothesis that physician productivity influences patient experience either directly or indirectly (productivity as the mediator) in the emergency department environment.

Overall, we find that very few of the pathways in this model are significant, suggesting that the model as a whole has very poor ‘fit’.

Reported results were confirmed and validated using a simultaneous equation approach available in Stata 12.

**References**

1. Klem L. Path Analysis. In: Grimm LG, Yarnold PR, editors. Reading and understanding multivariate statistics. American Psychological Association; 1995. p. 65.

2. Streiner DL. Finding our way: an introduction to path analysis. Can J Psychiatry. 2005 Feb;50(2):115-22