Learning by Doing or as Others Do

Christopher J. Cronin
University of Notre Dame

William N. Evans
University of Notre Dame
and NBER

Ethan M.J. Lieber
University of Notre Dame
and NBER

Richard Nelson
University of Utah

Economists have documented a positive association between output and productivity at the firm level (e.g., Levitt et al., 2013) and experience and productivity at the individual level (e.g., Haggag et al., 2017) across numerous industries. A large, related literature in medicine establishes that higher volume physicians and hospitals tend to have better outcomes (see Chowdhury et al., 2007 or Halm et al., 2002 for reviews). This result has been replicated in hundreds of studies across a variety of specific procedures. This statistical relationship is thought by many to be a result of learning by doing -- physicians gain valuable experience by performing more procedures. Identifying learning by doing is complicated by the fact that in most situations, patients have a choice of physicians and this relationship could be driven by the fact that patients gravitate towards physicians with the best outcomes. As a result, it has been difficult to convincingly document learning by doing.

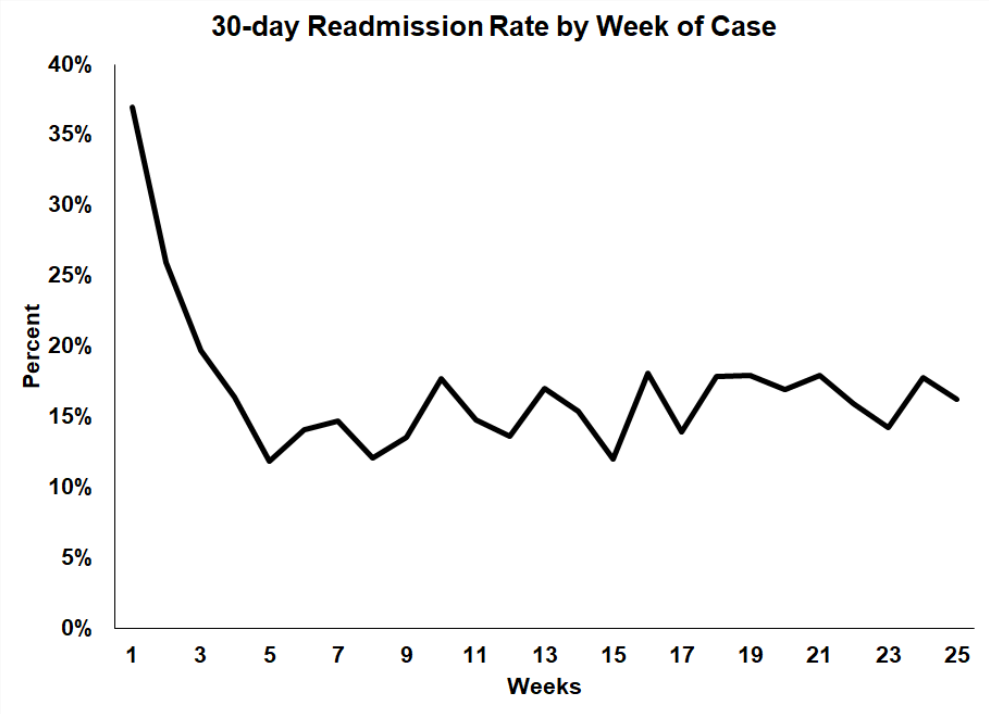
The COVID-19 pandemic provides a unique situation where one can test for learning by doing. Initially, it was not clear how to care for individuals who contracted the novel coronavirus, SARS-CoV-2. Medical practitioners experimented with various treatments and subsequent trials have shown that some treatments such as lopinavir-ritonavir and convalescent plasma did not improve outcomes (RECOVERY Collaborative Group, 2020; Janiaud et al., 2021) while others such as remdesivir and baricitinib can help some patients (Kalil et al., 2021). Over time, medical practitioners have gained experience with COVID-19 and have provided better care, mitigating the negative effects of COVID-19 on patients' health.

Previous research on physician learning by doing documents a correlation between patient outcomes and the stock of acquired knowledge by a physician, which is proxied by their current surgical volume. Given the novel nature of SARS-CoV-2, we can observe within a hospital the outcomes of the first through the most recent COVID-19 inpatient in the data set. Hospital staff learned a great deal about the virus in the early weeks of the pandemic and hence, holding patient acuity constant in a regression model, we should see that within a hospital, patient mortality from COVID-19 and hospital readmission rates decline as a hospital gains more experience with the disease.

We plan to use two datasets. The first contains electronic medical record data for any patient testing positive for COVID-19 across all 143 Veteran Administration (VA) hospitals in the US. The second contains the universe of inpatients with COVID-19 admitted to 130 hospitals in the state of Indiana. Key outcomes are 30-day mortality and readmission rates. Although only 57%

of inpatients in Indiana with positive COVID-19 tests are aged 65 and older, this group represents 87% of all deaths within 30 days of admission. If we increase the age window to include those 50 and above, the fraction of deaths within 30 days in this age group jumps to 98%. While the subject matter of our study is COVID-19 generically, the research is fundamentally about the elderly given the demographics of the disease.

In the figure below, we document a large, steep decline in the *unconditional* 30-day readmission rate among Indiana patients over the first 25 weeks of the pandemic. This pattern could be consistent with hospital physicians learning by doing (i.e., through their own interactions with COVID patients) or as others do (i.e., through an accumulation of information shared across facilities). Our main analysis will distinguish between these possibilities by exploiting the fact that hospitals get their first COVID-19 patients at very different times. This allows us to document the learning curves for hospitals that receive their first patients earlier and those that receive their first patients later. If those learning curves start off at very different points (lower readmission or mortality rates), then hospitals receiving their first patients later likely learned from others' doing. We also plan to examine whether this learning "as others do" is larger within hospital systems than across unaffiliated hospitals.



References:

Chowdhury, M. M., H. Dagash, and A. Pierro. "A systematic review of the impact of volume of surgery and specialization on patient outcome." *Journal of British Surgery* 94, no. 2 (2007): 145-161.

Haggag, Kareem, Brian McManus, and Giovanni Paci. "Learning by driving: Productivity improvements by New York City taxi drivers." *American Economic Journal: Applied Economics* 9, no. 1 (2017): 70-95.

Halm, Ethan A., Clara Lee, and Mark R. Chassin. "Is volume related to outcome in health care? A systematic review and methodologic critique of the literature." *Annals of internal medicine* 137, no. 6 (2002): 511-520.

Janiaud, Perrine, Catherine Axfors, and Andreas M Schmitt. “Association of Convalescent Plasma Treatment with Clinical Outcomes in Patients with COVID-19: A Systematic Review and Meta-analysis.” *JAMA*, 325(12): 1185-1195.

Kalil, A.C., T.F. Patterson, A.K. Mehta, K.M. Tomashek, C.R. Wolfe, V. Ghazaryan, V.C. Marconi, G.M. Ruiz-Palacios, L. Hsieh, S. Kline, V. Tapson, N.M. Iovine, M.K. Jain, D.A. Sweeney, H.M. El Sahly, A.R. Branche, J. Regalado Pineda, D.C. Lye, U. Sandkovsky, A.F. Luetkemeyer, S.H. Cohen, R.W. Finberg, P.E.H. Jackson, B. Taiwo, C.I. Paules, H. Arguinchona, N. Erdmann, N. Ahuja, M. Frank, M. Oh, E.-S. Kim, S.Y. Tan, R.A. Mularski, H. Nielsen, P.O. Ponce, B.S. Taylor, L.A. Larson, N.G. Rouphael, Y. Saklawi, V.D. Cantos, E.R. Ko, J.J. Engemann, A.N. Amin, M. Watanabe, J. Billings, M.-C. Elie, R.T. Davey, T.H. Burgess, J. Ferreira, M. Green, M. Makowski, A. Cardoso, S. de Bono, T. Bonnett, M. Proschan, G.A. Deye, W. Dempsey, S.U. Nayak, L.E. Dodd, and J.H. Beigel, for the ACTT-2 Study Group Members. “Baricitinib plus Remdesivir for Hospitalized Adults with Covid-19.” *The New England Journal of Medicine*, 384(9): 795-807.

Levitt, Steven D., John A. List, and Chad Syverson. "Toward an understanding of learning by doing: Evidence from an automobile assembly plant." *Journal of Political Economy* 121, no. 4 (2013): 643-681.

RECOVERY Collaborative Group. “Lopinavir-ritonavir in Patients Admitted to Hospital with COVID-19 (RECOVERY): a Randomized, Controlled, Open-label, Platform Trial.” *Lancet*, 396: 1345-1352.