



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Pharmacist-Led Education for Increasing Physician Comfort Prescribing Oral COVID-19 Antivirals

Two novel oral antiviral therapeutics, molnupiravir (Lagevrio; Merck) and ritonavir-boosted nirmatrelvir (Paxlovid; Pfizer Inc) (nirmatrelvir-ritonavir), were recently approved by the US Food and Drug Administration under an Emergency Use Authorization for the treatment of patients with mild to moderate coronavirus disease 2019 (COVID-19) at high risk of progression to severe disease.^{1,2} Unfamiliarity with these 2 agents and concerns related to institutional departmental workflows prompted primary care physicians to seek education from pharmacists. The result was development of an educational program for primary care teams with the fundamental goal of augmenting medication awareness and accessibility for patients. Herein we provide an account and model of how pharmacists' educational efforts effectively enhance physician and advanced practice provider comfort in prescribing oral COVID-19 antivirals and their understanding of current workflows and protocols at the institution.

The risk of hospitalization or death from moderate to severe COVID-19 has been shown to be reduced by 50% with molnupiravir and by 89% with nirmatrelvir-ritonavir when therapy is initiated within 5 days of symptom onset.^{3,4} Both medications interfere with viral replication. Nirmatrelvir-ritonavir interferes with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) main protease, preventing processing of polyprotein precursors, whereas molnupiravir metabolites are incorporated into viral RNA, resulting in viral genome errors. Adverse effects with these medications are comparable to placebo, and the medications likely have a more favorable tolerability profile than the existing COVID-19 vaccines. Common adverse effects include dysgeusia, nausea, diarrhea, headache, and muscle pain.⁵

The pharmacist's role has evolved in the past decade to support the growing needs of patient care, an aging geriatric population, and overall physician scarcity.⁶⁻⁸ Instead of

fulfilling their historical role as dispensing medication, pharmacists now embody the role of clinicians within complex specialties, including family medicine and primary care.⁷ Beyond their direct patient care role, pharmacists benefit physician—and team—education and knowledge, which benefits the overall quality of the team's patient care.^{9,10} A systematic review and meta-analysis by Jaam et al⁶ established that pharmacist educational programs are pivotal interventions that significantly decrease medication error rates, which can be sustained with subsequent educational programs (unlike single programs without continued follow-up or frequency of education). Indeed, the benefits of pharmacists' involvement extend beyond patient education to team-based learning. This is particularly true for medication information as new therapies become available for emerging and existing diseases.¹¹ More recently, with clinical knowledge of oral antiviral therapies for COVID-19, pharmacists have become experts in management of a new complex disease.¹²

Our institution's primary care teams were provided with a pharmacist-led educational program for the use of new COVID-19 antivirals according to the 4 core pillars of our developed Model of Education (efficacy, administration, availability, and affordability). The purpose of this model was to help the primary care teams understand the new medication workflow and the key logistical considerations discussed during the educational program that would effectively and efficiently promote physician knowledge of the 2 oral therapeutics (Figure).

Antiviral efficacy was reviewed and presented according to the available primary literature, data, and study results, which are some of the key elements that physicians have found to be valuable when pharmacists make clinical recommendations.¹¹ *Medication administration* included not only an overview of proper prescribing recommendations and patient eligibility criteria but also workflow optimization focused on diagnosis, drug selection, and patient education. Furthermore, *medication availability* and concurrent stock status within our institution's outpatient pharmacies were provided to the primary care teams. *Medication affordability* considerations were also discussed to address concerns for medication cost coverage. These 4 principles served as the knowledge foundation for the learners to

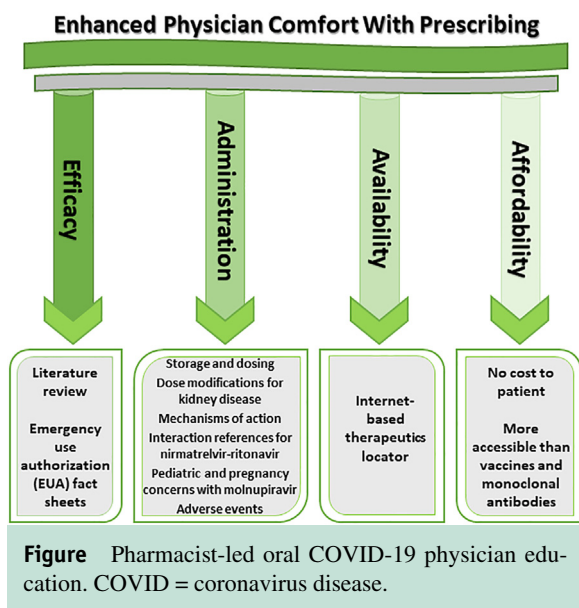
Funding: None.

Conflicts of Interest: None.

Authorship: All authors had access to the data and a role in writing this manuscript.

Requests for reprints should be addressed to Augustine S. Chavez, Department of Family Medicine, Mayo Clinic, 13400 E Shea Blvd, Scottsdale, AZ, 85259.

E-mail address: Chavez.Augustine@mayo.edu



reference beyond the educational program when tailoring individualized medication therapy for patients.

In addition to providing educational programs, pharmacists can be further integrated within a complex practice like primary care.¹⁰ As mentioned, pharmacists are valuable team members because they are drug experts who can share their knowledge with their colleagues.⁸ Thus, collaboration and the opportunity to build trust through knowledge sharing, professional respect, and team communication are key aspects of pharmacist integration within a team.¹¹ A focus on eradicating barriers for these opportunities is imperative when putting the needs of the patient first.

This educational program highlights one of many ways that pharmacists can use their skills as medication information experts. Future possible collaboration and integration opportunities, including educational programs for guideline updates and for new medication therapies as they emerge, are other ways that pharmacists can share their clinical knowledge to provide a more rounded team-based approach to patient care.^{7,8,11}

ACKNOWLEDGMENT

Randall J. Fritz, DVM, Mayo Clinic, substantively edited the manuscript. The Scientific Publications staff at Mayo Clinic provided proofreading, administrative, and clerical support.

Angela N. Coulter, PharmD, BCPS, BCACP^a
 Michael A. Campbell Jr., PharmD, BCACP^a
 Daniel T. Ilges, PharmD, BCIDP^b

Augustine S. Chavez, MD^c

^aPharmacy Services, Mayo Clinic,
 Scottsdale, Ariz

^bPharmacy Services, Mayo Clinic
 Hospital, Phoenix, Ariz

^cDepartment of Family Medicine,
 Mayo Clinic, Scottsdale, Ariz

References

- Food and Drug Administration. Fact sheet for healthcare providers: emergency use authorization for Paxlovid. Available at: <https://www.fda.gov/media/155050/download>. Accessed May 25, 2022.
- Food and Drug Administration. Fact sheet for healthcare providers: emergency use authorization for Lagevrio (molnupiravir) capsules. Available at: <https://www.fda.gov/media/155054/download>. Accessed May 26, 2022.
- Hammond J, Leister-Tebbe H, Gardner A, et al. Oral nirmatrelvir for high-risk, nonhospitalized adults with COVID-19. *N Engl J Med* 2022;386(15):1397–408. <https://doi.org/10.1056/NEJMoa2118542>.
- Jayk Bernal A, Gomes da Silva MM, Musungaie DB, et al. Molnupiravir for oral treatment of COVID-19 in nonhospitalized patients. *N Engl J Med* 2022;386(6):509–20. <https://doi.org/10.1056/NEJMoa2116044>.
- Wen W, Chen C, Tang J, et al. Efficacy and safety of three new oral antiviral treatment (molnupiravir, fluvoxamine and Paxlovid) for COVID-19a meta-analysis. *Ann Med* 2022;54(1):516–23. <https://doi.org/10.1080/07853890.2022.2034936>.
- Jaam M, Naserallah LM, Hussain TA, Pawluk SA. Pharmacist-led educational interventions provided to healthcare providers to reduce medication errors: A systematic review and meta-analysis. *PLoS One* 2021;16(6):e0253588. <https://doi.org/10.1371/journal.pone.0253588>.
- Hartkopf KJ, Heimerl KM, McGowan KM, Arndt BG. Expansion and evaluation of pharmacist services in primary care. *Pharmacy (Basel)* 2020;8(3):124. <https://doi.org/10.3390/pharmacy8030124>.
- Truong H, Kroehl ME, Lewis C, et al. Clinical pharmacists in primary care: provider satisfaction and perceived impact on quality of care provided. *SAGE Open Med* 2017;5:2050312117713911. <https://doi.org/10.1177/2050312117713911>.
- Musselman KT, Moczygemba LR, Pierce AL, Plum MF, Brokaw DK, Kelly DL. Development and Implementation of clinical pharmacist services within an integrated medical group. *J Pharm Pract* 2017;30(1):75–81. <https://doi.org/10.1177/0897190015617667>.
- Pestka DL, Paterson NL, Brummel AR, Norman JA, White KM. Barriers and facilitators to implementing pharmacist-provided comprehensive medication management in primary care transformation. *Am J Health Syst Pharm* 2022;79(15):1255–65. <https://doi.org/10.1093/ajhp/zxac104>.
- Amin S, McKeirnan KC. The physician perspective on pharmacist-physician collaboration and trust. *J Am Pharm Assoc (2003)* 2022;62(4):1304–12. <https://doi.org/10.1016/j.japh.2022.02.014>.
- Hughes DM, Mordino J. Pharmacist responsiveness and readiness for oral antivirals for COVID-19: a rebuttal to the AMA statement regarding the Biden administration's test-to-treat plan. *J Am Pharm Assoc (2003)* 2022;62(4):1162–4. <https://doi.org/10.1016/j.japh.2022.03.023>.