NorthShore
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Medical Group

Department of Medicine

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United States Department of Homeland Security
Citizenship and Immigration Services

RE: Recommendation on behalf of Ms. Urmila Ravichandran

Dear USCIS Officer,

As NorthShore University HealthSystem's Medical Director of Quality Innovation and Clinical Practice Analytics, I write to you to advocate for the approval of the immigrant petition on behalf of Ms. Urmila Ravichandran. Ms. Ravichandran, who NorthShore employs as a Data Scientist II, is an expert in applying data science to healthcare. Her pioneering research and industry contributions in Data Science and Analytics have revolutionized clinical decision systems, with potential applications that extend beyond the health care industry.

Within the field of data science and analytics, Ms. Ravichandran's ongoing work involves leveraging her expertise in comprehensive predictive model building to revolutionize clinical decision systems and champion health equity and accessibility, while also pioneering streamlined, AI-driven solutions to alleviate nurse, physician, and employee burnout. As detailed below, she has consistently proven herself a creative, innovative scientist with a growing record of novel, impactful achievements.

As Ms. Ravichandran's principal investigator at NorthShore and the operational lead for many of her projects, I have firsthand knowledge of her extraordinary achievements in applying her mastery of data science to solve key challenges in modern healthcare.

In addition to my working relationship with Ms. Ravichandran, I possess significant professional experience of my own that qualifies me to discuss her work and its impact. I am a leader in analytics, informatics, digital health, quality and innovation, and I work on cutting edge products that transform healthcare. My overall goal is to leverage technology

to improve outcomes and reduce costs while improving patient and provider experience. I have published over 40 manuscripts on topics including infectious diseases, informatics, analytics, and digital health in esteemed referred journals including the *New England Journal of Medicine*, the *Journal of Applied Clinical Informatics*, *Clinical Infectious Diseases*, and *Critical Care Medicine*. In addition to my Medical Directorship of Quality Innovation and Clinical Practice Analytics, I am also NorthShore's Director of Infectious Disease and Investigational Innovation Research, the Program Director of Outcomes Research for Quality and Transformation, and an Attending Infectious Disease Physician. I am also a Clinical Assistant Professor at the University of Chicago's Pritzker School of Medicine, where I also worked a preceding term as a Clinical Associate in Infectious Diseases. I hold an MD from Northwestern's Feinberg School of Medicine, and a Master of Public Health and a Bachelor of Arts in Biology and Economics, both from Northwestern.

Ms. Ravichandran's expertise is both impressive and increasingly vital to healthcare as a field. Healthcare systems are inherently intricate, and with this intricacy comes operational challenges and clinical complexities. Thus, specialized experts like Ms. Ravichandran are vital to the field's success, due to factors including:

1. Their ability to enhance efficiency and effectiveness by streamlining processes, optimizing resource allocation, and improving patient outcomes;
2. Their ability to address complex healthcare challenges by deploying advanced data science to extract actionable insights from vast and diverse datasets;
3. Their ability to foster health equity and accessibility by facilitating the identification of underserved populations and tailoring interventions to meet their specific needs; and
4. Their ability to advance research and clinical practices by leveraging advanced techniques such as natural language processing (NLP) and generative AI to extract valuable insights from disparate sources of data.

Ms. Ravichandran's deep knowledge of data science and mastery of its novel advanced technologies more than qualifies her to play a vital role in NorthShore's greater ongoing project of integrating data science into healthcare. As principal investigator and operational project lead for most of Ms. Ravichandran's work with NorthShore, I work closely with her daily. Our working relationship enables me to discuss the specifics of why and how her achievements are outstanding.

Ms. Ravichandran's accomplishments include:

1. **Empowering SDoH awareness and intervention through enhanced data accessibility**
   Ms. Ravichandran optimized NLP queries to accurately identify and categorize Social Determinants of Health (SDoH) within unstructured clinical notes and assisted with the deployment in clinical practice in each of our emergency departments (EDs) for all NorthShore patients. To illustrate the significance of this work in clinical practice, here are two case studies. In the first, a 20 to 30-year-old female in ED with headache, nausea, and dizziness was flagged by the NLP tool as potentially experiencing crime or abuse. This allowed a social worker to engage with the patient using a trauma-informed approach, leading to her referral for PTSD therapy and legal assistance. In the second case, a 39-year-old male presented to the ED for alcohol-related issues and was flagged by the NLP tool for "loss of employment." The social worker discovered he was struggling to access the Gateway program and provided referrals to detox and substance abuse resources. Ms. Ravichandran's contributions were instrumental in identifying and supporting individuals with unmet social needs, leading to a 56% increase in SDoH assessments at NorthShore, where such processes previously did not exist. Understanding SDoH is crucial as they determine and directly influence health outcomes. Lack of awareness about these factors within our patient population hinders comprehensive care delivery. Thanks to Ms. Ravichandran's efforts, leveraging technology, we can now address this gap effectively in our health system.

2. **Predicting maternal mortality and morbidity**
   Ms. Ravichandran contributed to the SAVE MOMS program by developing predictive models to identify patients at high risk for severe maternal morbidity (SMM), a group of life-threatening conditions that occur around the time of childbirth as defined by the Center for Disease Control (CDC). Collaborating with clinicians and analysts, Ms. Ravichandran delineated the demographic and clinical data necessary to build the model. The result of her thorough process was the development of two distinct models, one for risk stratification upon admission and another that incorporated vital signs to continuously assess risk, particularly in response to deteriorating vital signs. Compared to previously existing models, Ms. Ravichandran's models hold significantly higher area under the curve (AUC) values. AUC is a measure of how well a model can correctly identify high risk patients. Her work outperformed a system built by researchers from Stanford and UC Berkeley. Thanks to Ms. Ravichandran's model, NorthShore can stage interventions promptly, potentially preventing adverse health outcomes and reducing

maternal mortality rates, a major step towards countering the United States' maternal mortality crisis.

3. **Applying propensity matching techniques to assess the effectiveness of interdisciplinary committees in ensuring safe transitions to congregate living facilities**

   Ms. Ravichandran played a critical role in assessing the appropriateness of skilled nursing facility (SNF) utilization decisions made by a multidisciplinary committee following hospitalization during the COVID-19 pandemic. Given the high rate of infection observed within SNFs during the pandemic, careful consideration and evaluation of discharge decisions was necessary to ensuring patient safety. She designed the study, ensuring that its methodology was robust and aligned with its objectives. She also facilitated the derivation of cohorts, ensuring that the study's sample accurately represented the population under study. She headed data extraction and preparation, ensuring its accuracy and reliability for subsequent analysis. What makes the study unique is its decision to address a common challenge healthcare facilities face, determining the suitability of patients for transfer to SNFs. Historically, this was a decision made on an individual level. This project, by contrast, combined the collective expertise of a multidisciplinary team including physicians, case manager, social workers, physical and occupational therapists, and home-health representatives. The team introduced a systematic process where they would review all patients anticipated for SNF in order to achieve a consensus decision. Ms. Ravichandran was pivotal in facilitating the evaluation of the committee's decision-making process and quantifying its effectiveness through her rigorous study design and meticulous propensity matching analysis. Her contributions made it possible for the project to ascertain the benefits of the review committee by guaranteeing the analytical depth necessary to do so. The result of the project was a significant reduction in SNF utilization that did not compromise either patient safety or hospital efficiency amidst the COVID-19 pandemic, as well as a valuable reference for hospitals aiming to mitigate COVID-19 risks in SNFs. More broadly, the project's emphasis on collaborative decision-making holds the potential to influence future healthcare practices, especially in infection control. Its significance has been highlighted by its recognition in a special editorial in the Journal of Hospital Medicine, reinforcing the relevance and potential impact of implementing similar collaborative approaches nationwide.

4. **Facilitating the study of machine learning early warning risk scores on patient mortality**

   Ms. Ravichandran used her mastery of data extraction and analysis to make a key contribution to the study of eCART, a machine learning-based early warning risk score. To do this, she built intricate structure query language (SQL) queries to retrieve the essential data efficiently. She built automated scripts in the programming language R that made it possible to reuse code for data preparation and analysis. Given the complexity and variability of healthcare data, Ms. Ravichandran formulated a detailed extraction plan that ensured the acquisition of data points key to determining the intervention's effectiveness using the early warning risk score. Before her involvement, the data extraction process had languished for over two years with no progress. Thanks to her expertise, we were able to achieve in just two weeks what had previously seemed laborious and unattainable. I myself used it as the basis for a paper, "The Impact of a Machine Learning Early Warning Score on Hospital Mortality: A Multicenter Clinical Intervention Trial."

5. **Developing a clinical decision support tool for the identification, diagnosis, and treatment of critical illness in hospitalized patients as part of NIH study R01 HL157262-01.**

   Ms. Ravichandran contributed to NIH study 1 R01 HL157262-01 by actively participating in the ongoing development of a clinical decision support tool that leverages datasets curated from NLP techniques applied to over a decade of unstructured clinical notes. At NorthShore, she spearheaded the extraction of critical data, utilizing clinical text analysis and the knowledge extraction system (cTAKES) to extract structured data related to comorbidities, labs, medications, and more. She automated a sophisticated data extraction and processing pipeline, ensuring the seamless conversion of notes into structured data while implementing rigorous de-identification measures to enable data democratization and partnership with other health systems. This effort significantly reduced data extraction time from several months to several days. Currently, we are leveraging the rich dataset created by Ms. Ravichandran to identify, diagnose, and treat patients at high risk of deterioration by combining NLP techniques and machine learning models. Utilizing such complex data, rather than relying solely on vital signs, enables us to create highly accurate tools that address the limitations of current systems, thus improving patient outcomes. In short, Ms. Ravichandran's skills enable the development

of models for early, accurate, and potentially life-saving interventions in cases where deterioration is a risk.

Given the scope and scale of her accomplishments at NorthShore, it is clear to me that Ms. Urmila Ravichandran is an extraordinary data scientist. Furthermore, her abilities extend beyond data science and encompass software engineering, research, generative AI, project management, and more. Her work supports an endeavor (healthcare) that is vital to the United States' continuing as a leader in the field and to the nation's continuing work to maintain its wellness. Her expertise does not just enable these innovations to succeed; it makes them possible in the first place. She is, to put it simply, the right expert in the right place and at the right time. As her principal investigator and operational lead, and as a professional, I will confidently assert that the United States would benefit tremendously from waiving its usual labor requirements for her. She has my backing and my endorsement.

Please do not hesitate to contact me if you have any questions about Ms. Ravichandran or her work for NorthShore University HealthSystem.

Sincerely,

Nirav Shah, MD, MPH
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