Stanford



Roberto Novoa, MD

- Clinical Professor, Pathology
- Clinical Professor, Dermatology
- Curriculum Vitae available Online

CLINICAL OFFICE (PRIMARY)

- **Department of Pathology**

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Bio

BIO

Dr. Novoa received his bachelor and medical degrees from Harvard University. He completed his medical internship at Columbia University Medical Center and his dermatology residency at University Hospitals-Case Western Reserve School of Medicine before pursuing a dermatopathology fellowship at the University of Pennsylvania. Board certified in dermatology and dermatopathology, Dr. Novoa practices clinical dermatology and interprets slides as a dermatopathologist. His research interests include the medical applications of artificial intelligence, cutaneous lymphoma, and the cutaneous side effects of targeted therapies. Dr. Novoa served as co-PI on a research project featured on the cover of Nature Magazine. This work has appeared in the Wall Street Journal, Bloomberg Magazine, and PBS NOVA. He enjoys travel, reading, and Brazilian Jiu Jitsu.

CLINICAL FOCUS

- Dermatopathology
- Anatomic and Clinical Pathology

ACADEMIC APPOINTMENTS

- Clinical Professor, Pathology
- Clinical Professor, Dermatology

ADMINISTRATIVE APPOINTMENTS

- Associate Program Director, Stanford Dermatopathology Division, (2017- present)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Member, Appropriate Use Criteria Committee, American Society of Dermatopathology (2016 - present)
- Fellow, American Academy of Dermatology (2013 - present)
- Fellow, American Society of Dermatopathology (2014 - present)

PROFESSIONAL EDUCATION

- Residency: Case Western Reserve University and University Hospitals Cleveland Medical Center (2013) OH
- Internship: New York Presbyterian Columbia Campus Internal Medicine Residency (2010) NY
- Fellowship: University of Pennsylvania Hospital (2014) PA
- Medical Education: Harvard Medical School (2009) MA
- Board Certification: Dermatopathology, American Board of Dermatology (2014)
- Board Certification: Dermatology, American Board of Dermatology (2013)
- Residency, Case Western Reserve University School of Medicine- University Hospitals , Dermatology (2013)
- Fellowship, University of Pennsylvania , Dermatopathology (2014)

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Recent advances in artificial intelligence stand poised to transform a number of human endeavors. A new approach, known as deep learning, harnesses large datasets, increased computing power, and convolutional neural networks to enable algorithms to discern complex patterns in raw data. These algorithms are widely used in autonomous vehicles, language translation, and image classification. Within medicine, these algorithms have been applied to a wide range of questions, ranging from detection of atrial fibrillation or breast cancer to prediction of ICU mortality. This same approach to pattern recognition can be applied to visual diagnosis of skin lesions, including melanoma.

Currently, melanoma is responsible for nearly 10,000 annual deaths in the United States alone, and early diagnosis is critical to cure. Furthermore, melanoma mortality demonstrates various disparities, with worse outcomes for patients of low socioeconomic status or those living in rural areas. In addition, keratinocyte carcinomas are the most common human malignancy, with over 5 million cases a year in the United States and thousands of deaths from aggressive local or metastatic disease.

Using deep learning techniques, we created a convolutional neural network (CNN) trained on 129,000 skin images and a morphological taxonomy composed of over 2000 disease categories. In a proof-of-concept study, our CNN demonstrated classification performance on par with 21 board-certified dermatologists across a range of tasks, including clinical and dermoscopic evaluation of melanocytic lesions. On expanded validation datasets, the algorithms showed comparable performance. More remains to be done, however, in order to validate this algorithm and examine its performance on prospective lesions. Furthermore, deep learning techniques struggle with 1) bias; 2) interpretability; 3) a lack of data; and 4) challenges with adversarial examples, where minute changes in angle or lighting can produce radically different outputs. In the next steps of our research, we seek to tackle these challenges while working on a prospective clinical trial of this technology in the real world.

CLINICAL TRIALS

- DERM US and EU Validation Study, Not Recruiting

Publications

PUBLICATIONS

- **Automated Classification of Skin Lesions: From Pixels to Practice.** *The Journal of investigative dermatology*
  Narla, A., Kuprel, B., Sarin, K., Novoa, R., Ko, J.
  2018; 138 (10): 2108–10
- **Dermatologist-level classification of skin cancer with deep neural networks.** *Nature*
  Esteva, A., Kuprel, B., Novoa, R. A., Ko, J., Swetter, S. M., Blau, H. M., Thrun, S.
  2017; 542 (7639): 115-118
- **ALK-positive compound Spitz nevus with extensive perineural and intraneural neurotropism.** *Journal of cutaneous pathology*

Brown, R. A., Wang, J. Y., Raghavan, S. S., Zhang, J., Wan, D. C., Born, D., Koo, M., Hazard, F. K., Novoa, R. A., Rieger, K. E.
2020

- **Cutaneous T-cell lymphomas with pathogenic somatic mutations and absence of detectable clonal T-cell receptor gene rearrangement: two case reports.** *Diagnostic pathology*
  Rojansky, R., Fernandez-Pol, S., Wang, E., Rieger, K. E., Novoa, R. A., Zehnder, J. L., Kunder, C. A., Kim, Y. H., Khodadoust, M. S., Brown, R. A.
  2020; 15 (1): 122

- **Imatinib as a potentially effective therapeutic alternative in corticosteroid-resistant eosinophilic fasciitis.** *Pediatric dermatology*
  Wu, T. T., Goodarzi, H., Wang, J., Novoa, R., Teng, J. M.
  2020

- **PRAME expression in melanocytic proliferations with intermediate histopathologic or spitzoid features.** *Journal of cutaneous pathology*
  Raghavan, S. S., Wang, J. Y., Kwok, S., Rieger, K. E., Novoa, R. A., Brown, R. A.
  2020

- **Differentiation syndrome during ivosidenib treatment with immunohistochemistry showing isocitrate dehydrogenase R132H mutation.** *Journal of cutaneous pathology*
  Tabata, M. M., Chase, M., Kwong, B. Y., Novoa, R. A., Fernandez-Pol, S.
  2020

- **Diagnostic Utility of LEF1 Immunohistochemistry in Differentiating Deep Penetrating Nevi From Histologic Mimics.** *The American journal of surgical pathology*
  Raghavan, S. S., Saleem, A., Wang, J. Y., Rieger, K. E., Brown, R. A., Novoa, R. A.
  2020

- **Shoshin beriberi in a patient with oral and cutaneous graft-versus-host disease.** *JAAD case reports*
  Hodgkinson, L. M., Shah, A., Bae, G. H., Novoa, R., Kwong, B. Y.
  2020; 6 (5): 420-421

- **TERT and TERT promoter in melanocytic neoplasms: current concepts in pathogenesis, diagnosis, and prognosis.** *Journal of cutaneous pathology*
  Motaparthi, K., Kim, J., Andea, A. A., Missall, T. A., Novoa, R. A., Vidal, C. I., Fung, M. A., Emanuel, P. O.
  2020

- **Cutaneous Pleomorphic Fibromas Arising in Patients with Germline TP53 Mutations.** *Journal of cutaneous pathology*
  Cloutier, J. M., Shalin, S. C., Lindberg, M., Gardner, J. M., Fernandez-Pol, S., Zaba, L., Novoa, R., Brown, R. A.
  2020

- **Disseminated Tuberculosis Presenting as Medium-Vessel Vasculitis in an Immunocompromised Host.** *Journal of cutaneous pathology*
  Wang, J. Y., Brown, R. A., Pugliese, S., Kwong, B. Y., Novoa, R. A.
  2020

- **Comparison of C3d immunohistochemical staining to ELISA and immunofluorescence for diagnosis of bullous pemphigoid.** *Journal of the American Academy of Dermatology*
  Wang, L. L., Moshiri, A. S., Novoa, R., Simpson, C. L., Takeshita, J., Payne, A. S., Chu, E. Y.
  2020

- **Histopathologic Characterization of Mogamulizumab-associated Rash.** *The American journal of surgical pathology*
  Wang, J. Y., Hirotsu, K. E., Neal, T. M., Raghavan, S. S., Kwong, B. Y., Khodadoust, M. S., Brown, R. A., Novoa, R. A., Kim, Y. H., Rieger, K. E.
  2020

- **Simultaneous Coccidioidomycosis and Phaeohyphomycosis in a Kidney Transplant Recipient: A Case Report and Literature Review.** *Transplant infectious disease : an official journal of the Transplantation Society*
  Puing, A. G., Couture-Cossette, A. n., Wang, A. X., Zygourakis, C. C., Cheng, X. n., Stevens, B. A., Banaei, N. n., Novoa, R. A., Ho, D. Y., Subramanian, A. n.
  2020: e13365

- **Shoshin beriberi in a patient with oral and cutaneous graft-versus-host disease** *JAAD Case Reports*
  Hodgkinson, L. M., Shah, A., Bae, G. H., Novoa, R., Kwong, B. Y.
  2020; 6 (5): 420-421

- **Diffuse PRAME expression is highly specific for malignant melanoma in the distinction from clear cell sarcoma.** *Journal of cutaneous pathology*
  Raghavan, S. S., Wang, J. Y., Toland, A. n., Bangs, C. D., Rieger, K. E., Novoa, R. A., Charville, G. W., Brown, R. A.
  2020
- **Reticulohistiocytoma (solitary epithelioid histiocytoma) with mutations in RAF1 and TSC2.** *Journal of cutaneous pathology*
  Bahrani, E. n., Fernandez-Pol, S. n., Wang, J. Y., Aasi, S. Z., Brown, R. A., Novoa, R. A.
  2020
- **Inflammatory alopecia in patients on dupilumab: a retrospective cohort study at an academic institution.** *Journal of the European Academy of Dermatology and Venereology : JEADV*
  Zhu, G. A., Kang, K. J., Chen, J. K., Novoa, R. A., Brown, R. A., Chiou, A. S., Ko, J. M., Honari, G.
  2019
- **Validation of Image Quality and Diagnostic Accuracy Using a Mobile Phone Camera Microscope Adaptor Compared With Glass Slide Review in Teledermatopathology.** *The American Journal of dermatopathology*
  Laggis, C. W., Bailey, E. E., Novoa, R., Stewart, C. L., Stoff, B., Wanat, K. A., Barbieri, J., Kovarik, C.
  2019
- **Marking the Path Toward Artificial Intelligence-Based Image Classification in Dermatology.** *JAMA dermatology*
  Novoa, R. A., Gevaert, O., Ko, J. M.
  2019
- **Atypical Fibroxanthoma and Pleomorphic Dermal Sarcoma Updates on Classification and Management** *DERMATOLOGIC CLINICS*
  Soleymani, T., Aasi, S. Z., Novoa, R., Hollmig, S.
  2019; 37 (3): 253-+
- **Atypical Fibroxanthoma and Pleomorphic Dermal Sarcoma: Updates on Classification and Management.** *Dermatologic clinics*
  Soleymani, T., Aasi, S. Z., Novoa, R., Hollmig, S. T.
  2019; 37 (3): 253–59
- **Biomarker discovery analysis: Alterations in p14, p16, p53, and BAP1 expression in nevi, cutaneous melanoma, and metastatic melanoma** *PIGMENT CELL & MELANOMA RESEARCH*
  Sargen, M. R., Cloutier, J. M., Sarin, K. Y., Rieger, K. E., Chu, P., Swetter, S. M., Novoa, R. A.
  2019; 32 (3): 474–78
- **Dermatology, Data, and Informatics INTRODUCTION** *SEMINARS IN CUTANEOUS MEDICINE AND SURGERY*
  Novoa, R.
  2019; 38 (1): E1–E2
- **Artificial intelligence and dermatology: opportunities, challenges, and future directions** *SEMINARS IN CUTANEOUS MEDICINE AND SURGERY*
  Schlessinger, D. I., Chhor, G., Gevaert, O., Swetter, S. M., Ko, J., Novoa, R. A.
  2019; 38 (1): E31–E37
- **Artificial intelligence and dermatology: opportunities, challenges, and future directions.** *Seminars in cutaneous medicine and surgery*
  Schlessinger, D. I., Chhor, G., Gevaert, O., Swetter, S. M., Ko, J., Novoa, R. A.
  2019; 38 (1): E31–37
- **Introduction, Dermatology, Data, and Informatics.** *Seminars in cutaneous medicine and surgery*
  Novoa, R. A.
  2019; 38 (1): E1–E8
- **Biomarker discovery analysis: Alterations in p14, p16, p53, and BAP1 expression in nevi, cutaneous melanoma, and metastatic melanoma.** *Pigment cell & melanoma research*
  Sargen, M. R., Cloutier, J. M., Sarin, K. Y., Rieger, K. E., Chu, P., Swetter, S. M., Novoa, R. A.
  2019
- **Appropriate use criteria in dermatopathology: Initial recommendations from the American Society of Dermatopathology.** *Journal of the American Academy of Dermatology*

Task Force/Committee Members, Vidal, C. I., Armbrect, E. A., Andea, A. A., Bohlke, A. K., Comfere, N. I., Hughes, S. R., Kim, J., Kozel, J. A., Lee, J. B., Linos, K., Litzner, B. R., Missall, T. A., et al
2019; 80 (1): 189

- **Evidence behind the use of molecular tests in melanocytic lesions and practice patterns of these tests by dermatopathologists** *JOURNAL OF CUTANEOUS PATHOLOGY*
  Emanuel, P. O., Andea, A. A., Vidal, C. I., Missall, T. A., Novoa, R. A., Bohlke, A. K., Hughes, S. R., Hurley, M. Y., Kim, J.
  2018; 45 (11): 839–46
- **Paraneoplastic granulomatous dermatitis in a patient with Hodgkin's disease: a diagnostic pitfall.** *BMJ case reports*
  Tabata, M. M., Novoa, R. A., Martires, K. J.
  2018; 2018
- **Appropriate use criteria in dermatopathology: Initial recommendations from the American Society of Dermatopathology** *JOURNAL OF CUTANEOUS PATHOLOGY*
  Vidal, C. I., Armbrect, E. A., Andea, A. A., Bohlke, A. K., Comfere, N. I., Hughes, S. R., Kim, J., Kozel, J. A., Lee, J. B., Linos, K., Litzner, B. R., Missall, T. A., Novoa, et al
  2018; 45 (8): 563–80
- **Variability in the Expression of Immunohistochemical Markers: Implications for Biomarker Interpretation in Cutaneous T-Cell Lymphoma** *JOURNAL OF INVESTIGATIVE DERMATOLOGY*
  Rahbar, Z., Li, S., Tavallaee, M., Novoa, R. A., Kim, J., Kim, Y. H.
  2018; 138 (5): 1204–6
- **Gain of CD26 expression on the malignant T-cells in relapsed erythrodermic leukemic mycosis fungoides.** *Journal of cutaneous pathology*
  Cedeno-Laurent, F., Wysocka, M., Obstfeld, A. E., Novoa, R. A., Vittorio, C. C., Kim, E. J., Weng, W., Rook, A. H.
  2017
- **Development of RET mutant cutaneous angiosarcoma during BRAF inhibitor therapy.** *Journal of cutaneous pathology*
  Dai, J. n., Kunder, C. A., Chu, E. Y., Chan, E. F., Egan, C. L., Novoa, R. A.
  2017
- **Invasive Melanoma in a Patient with Congenital Ichthyosiform Erythroderma** *PEDIATRIC DERMATOLOGY*
  Jaju, P., Novoa, R. A., Swetter, S. M., Sarin, K. Y.
  2017; 34 (1): E35-E36
- **Invasive Melanoma in a Patient with Congenital Ichthyosiform Erythroderma.** *Pediatric dermatology*
  Jaju, P., Novoa, R. A., Swetter, S. M., Sarin, K. Y.
  2016
- **Low-Dose Radiotherapy for Primary Cutaneous Anaplastic Large-Cell Lymphoma While on Low-Dose Methotrexate** *CUTIS*
  Cornejo, C. M., Novoa, R. A., Krisch, R. E., Kim, E. J.
  2016; 98 (4): 253-256
- **Epidermotropic metastasis of primary lung adenocarcinoma.** *Journal of cutaneous pathology*
  Scott, G. D., Kwong, B. Y., Novoa, R. A.
  2016; 43 (9): 798-801
- **Carpet beetle dermatitis: a possibly under-recognized entity** *INTERNATIONAL JOURNAL OF DERMATOLOGY*
  MacArthur, K. M., Richardson, V., Novoa, R. A., Stewart, C. L., Rosenbach, M.
  2016; 55 (5): 577-579
- **Immunohistochemical analysis of lichenoid reactions in patients treated with anti-PD-L1 and anti-PD-1 therapy.** *Journal of cutaneous pathology*
  Schaberg, K. B., Novoa, R. A., Wakelee, H. A., Kim, J., Cheung, C., Srinivas, S., Kwong, B. Y.
  2016; 43 (4): 339-346
- **Fistulizing Epstein-Barr virus-positive plasmablastic lymphoma in an HIV-positive man** *BRITISH JOURNAL OF DERMATOLOGY*
  Rangel, J., Novoa, R., Morrison, C., Frank, D., Kovarik, C.
  2016; 174 (2): 398-401

- **Erythematous Plaques on the Buttock** *JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION*
  Tan, C. Z., Novoa, R., Chen, J. K.
  2016; 315 (1): 79-80
- **Recurrent Subepidermal Blistering Dermatosis Heralding Disease Relapse in IgA Kappa Multiple Myeloma: Report of a Case and a Review of the Literature.** *Clinical lymphoma, myeloma & leukemia*
  Leatham, H. W., Novoa, R., Liedtke, M., Kwong, B. Y.
  2016; 16 (1): e1-5
- **Acquired port-wine stain with superimposed eczema following penetrating abdominal trauma.** *Cutis*
  Langenhan, J., Novoa, R. A., Pappas-Taffer, L.
  2015; 96 (6): 391-394
- **Presentation of Acute Megakaryoblastic Leukemia Associated with a GATA-1 Mutation Mimicking the Eruption of Transient Myeloproliferative Disorder** *PEDIATRIC DERMATOLOGY*
  Boos, M. D., Lee, L. W., Freedman, J. L., Novoa, R. A., Chu, E. Y., Perman, M. J.
  2015; 32 (5): E204-E207
- **Erythrodermic Leukemia Cutis in a Patient With Pre-B-Cell Acute Lymphoblastic Leukemia.** *American Journal of dermatopathology*
  Novoa, R. A., Wanat, K. A., Rosenbach, M., Frey, N., Frank, D. M., Elenitsas, R.
  2015; 37 (8): 650-652
- **Herlitz Junctional Epidermolysis Bullosa with a Novel Mutation in LAMB3** *PEDIATRIC DERMATOLOGY*
  Kittridge, A., Patel, R., Novoa, R., Tamburro, J.
  2014; 31 (4): 530-532
- **Hypertensive Emergency, Matlike Telangiectasias, and Calciphylaxis in POEMS Syndrome** *JAMA DERMATOLOGY*
  Novoa, R. A., Honda, K. S., Campagnaro, E., Gerstenblith, M. R.
  2014; 150 (6): 667-669
- **Cutaneous epithelioid melanocytic neurofibroma arising in a patient with neurofibromatosis-1** *JOURNAL OF CUTANEOUS PATHOLOGY*
  Novoa, R. A., Kovarik, C. L., Low, D. W., Argenyi, Z.
  2014; 41 (5): 457-461
- **Cutaneous Complications in Hematopoietic Cell Transplant Recipients: Impact of Biopsy on Patient Management** *BIOLOGY OF BLOOD AND MARROW TRANSPLANTATION*
  Paun, O., Phillips, T., Fu, P., Novoa, R. A., Honda, K. S., Lug, K. Q., Lazarus, H. M.
  2013; 19 (8): 1204-1209
- **Acneiform eruptions associated with vemurafenib** *JOURNAL OF THE AMERICAN ACADEMY OF DERMATOLOGY*
  Petukhova, T. A., Novoa, R. A., Honda, K., Koon, H. B., Gerstenblith, M. R.
  2013; 68 (3): E97-E99
- **Vasculitis and panniculitis associated with vemurafenib** *JOURNAL OF THE AMERICAN ACADEMY OF DERMATOLOGY*
  Novoa, R. A., Honda, K., Koon, H. B., Gerstenblith, M. R.
  2012; 67 (6): E271-E272
- **IL-17 and Regulatory Cytokines (IL-10 and IL-27) in L-braziliensis Infection** *PARASITE IMMUNOLOGY*
  NOVOA, R., Bacellar, O., Nascimento, M., Cardoso, T. M., Ramasawmy, R., OLIVEIRA, W. N., Schriefer, A., Carvalho, E. M.
  2011; 33 (2): 132-136
- **Ecstasy use and its association with sexual behaviors among drug users in New York City** *JOURNAL OF COMMUNITY HEALTH*
  Novoa, R. A., Ompad, D. C., Wu, Y. F., Vlahov, D., Galea, S.
  2005; 30 (5): 331-343