NATIONAL JEWISH HEALTH

Curriculum Vitae

NAME: Stephen M. Humphries PROFESSIONAL DEGREES: PhD, MS

I. ACADEMIC HISTORY

University of Colorado Denver	PhD	Bioengineering	2015
University of Colorado Denver	MS	Bioengineering	2012
University of Colorado Health Sciences Center	MS	Medical Physics	1996
Connecticut College	BA	Physics	1993

II. PROFESSIONAL POSITIONS

2021 - Associate Professor and Director, Quantitative Imaging Laboratory, Dept. of Radiology, National Jewish Health, Denver, CO

2015 - 2021 Assistant Professor and Director, Quantitative Imaging Laboratory, Dept. of Radiology, National Jewish Health, Denver, CO

2012 - 2015 Research Affiliate, Quantitative Imaging Laboratory Dept. of Radiology, National Jewish Health, Denver, CO

2006 - 2010 Medical Physicist, Rocky Mountain CyberKnife, Boulder, CO

2003 - 2006 Director of Business Development, Medical Modeling, Golden, CO

2002 – 2003 Product Manager, Academic Affiliations, Stryker Navigation, Kalamazoo, MI

1999 - 2001 Senior Specialist - Image Guided Surgery, Stryker Leibinger, Kalamazoo, MI

1998 - 1999 Assistant Professor, Medical Physicist, Department of Radiation Oncology, University of Colorado Health Sciences Center, Denver, CO

1996 - 1998 Instructor, Medical Physicist, Department of Radiation Oncology, University of Colorado Health Sciences Center, Denver, CO

III. ACADEMIC HONORS

A. SCHOLARSHIPS AND FELLOWSHIPS

B. SPECIAL RECOGNITIONS

1. David Fenton Award for Excellence in Physics, Connecticut College, May 1993.
2. NSF Science and Engineering Visualization Challenge, 1st Place Interactive Media Category, “Cerebral Vasculature of Conjoined Twins”, May 2006.
3. Outstanding Graduate Student in Bioengineering, UC Denver, May 2012.
4. Best Poster, Translational Science category, Dept. of Medicine Research Retreat, National Jewish Health, Feb. 2018.

C. INVITED LECTURES

1. "Quantification of pulmonary fibrosis on CT", Imaging Elevated: Utah Symposium for Emerging Investigators, September 30, 2017.

2. "Quantification of pulmonary fibrosis on CT", Open Source Imaging Consortium (OSIC), Frankfurt, Germany November 13-14, 2017.
3. "Artificial Intelligence-powered Quantitative Imaging", 6th Annual Colorado Radiology Leadership Summit, May 11, 2018.
4. "Deep learning classification of emphysema on CT", 2019 Int'l Workshop on Pulmonary Imaging, University of Pennsylvania, March 1, 2019.
5. "Deep learning in IPF", Int'l Workshop on Pulmonary Functional Imaging (IWPFI), New Orleans, October 17, 2019
6. "Quantitative CT analysis using AI", SCBT-MR, Denver, October 18, 2019.
7. "New HRCT quantitative methods to enhance trial design and clinical assessment", Pulmonary Fibrosis Foundation Summit, San Antonio, November 8, 2019.
8. "Quantitative CT in RA-ILD", TRAIL-1 Investigators Meeting, London, England, January 31, 2020.
9. "Quantitative and Semi-Quantitative CT in Parenchymal Lung Diseases", Sociedade Portuguesa Pneumologia, Congresso de Pneumologia, November 14, 2020 (virtual).
10. "Deep learning classification of emphysema severity", Dept. of Bioengineering, University of Iowa, January 2021 (virtual).
11. "Updates from the COPDGene Study: Imaging and Deep Learning", American Thoracic Society, May 2021.
12. "Quantitative and Semi-Quantitative Imaging in Parenchymal Lung Diseases", CHEST 2021 Annual Meeting, Oct 18, 2021 (virtual).
13. "Artificial intelligence in thoracic imaging", Turkish Respiratory Society 43rd Annual Congress. Oct 30, 2021 (virtual).
14. "Deep learning for quantitative CT", World Association for Sarcoidosis and Other Granulomatous Disorders (WASOG) Conference 2021. Nov. 30, 2021 (virtual).

IV. PROFESSIONAL SOCIETIES AND HONORARY SOCIETIES

2013 – present	American Thoracic Society
2016 – present	Society for Imaging Informatics in Medicine (SIIM)

V. COMMITTEE PARTICIPATION AND OTHER SERVICE ACTIVITIES

A. INSTITUTION

1. National Jewish Health Research / IST Steering Committee
2. National Jewish Health MicroCT Advisory Committee
3. National Jewish Health Research Advisory Committee

B. NATIONAL

1. RSNA Quantitative Imaging Biomarker Alliance, Lung Density Biomarker Committee
2. COPDGene Imaging Committee
3. COPDGene Ancillary Studies and Publications Committee

VI. PATENTS HELD OR PENDING

1. US 10,706,533 (issued July 2022) and US 11,468,564 (issued October 2022) "Systems and Methods for Automatic Detection and Quantification of Pathology Using Dynamic Feature Classification"
2. US Pat App 16/412,120 "Systems and Methods for Classifying Severity of COPD" (pending)
3. US Pat App "System and methods for quantitative assessment of nasal sinuses" (pending)

VII. REVIEW ACTIVITIES

Ad hoc reviews for:

American Journal of Respiratory and Critical Care Medicine
Annals of the American Thoracic Society
British Journal of Radiology
CHEST
European Radiology
European Respiratory Journal
International Forum of Allergy & Rhinology
Journal of MRI
Journal of Thoracic Imaging
Medical and Biological Engineering and Computing
Medical Image Analysis
Medical Physics
Scientific Reports

VIII. TEACHING ACTIVITIES

MENTEES:

1. Timothy Browne, M.S. Program in Modern Human Anatomy, Univ. of Colorado Denver, Research mentor, Capstone Project: "Statistical Shape Modeling of Normal Adult Lungs" (Spring 2016).
2. Emily Mastej, M.S. Program in Modern Human Anatomy, Univ. of Colorado Denver, Research co-mentor, Capstone Project: "Development of Software for Automatic Airway Count on CT" (Spring 2016).
3. Kenneth Milligan, M.S. Bioengineering, Univ. of Colorado Denver, Research co-mentor, thesis: "Morphometric Analysis of the Sacrum Using Statistical Shape Modeling" (Spring 2016).
4. Henry Madsen, M.S. Bioengineering, Univ. of Colorado Denver, Research co-mentor, thesis: "Spectral decomposition of electrocardiograms for diagnosis of pulmonary hypertension and estimation of invasively measured parameters" (Spring 2017).
5. Justin Gerow, undergrad biomedical engineering student Univ. of South Carolina, QIL internship (Summer 2018).
6. Conner Massey MD, Resident physician, UC Denver Dept or Otolaryngology, American Academy of Otolaryngology-Head and Neck Surgery Foundation 2019 Resident Research Grant, "Using automated machine learning to volumetrically analyze sinus CT" (co-mentor with Vijay Ramakrishnan, MD 2019-2020).

IX. RESEARCH GRANTS AND CONTRACTS:

A. PAST FUNDING

HHSN268201500021C (U) (PI: Humphries) 12/1/2016 – 3/31/2018
RSNA/QIBA $56,829
CT Lung Density Biomarker: Translating Phantom Harmonization to Clinical Practice
The goals of this study are 1) to disseminate a novel methodology for phantom-based calibration of CT lung density metrics to an ongoing clinical research trial and 2) to demonstrate that this calibration reduces variation in measures of emphysema, specifically RA-950 and Perc15, obtained with both low and conventional dose CT.

Advanced Industries Accelerator Grant (PI: Humphries) 6/1/2017 – 5/31/2019 0.0 calendar
State of Colorado $17,594
Volumetric Quantification of Rhinosinusitis on CT
Goals: To develop and validate an efficient computational method for quantification of the severity of rhinosinusitis on CT scans.

B. CURRENT FUNDING

1U01 HL089897 (PI: Crapo) 12/1/17 – 11/30/2022 5.4 calendar

NIH/NHLBI $60,255
Genetic Epidemiology of COPD
Goals: We will perform 10-year follow-up of all available COPD Gene subjects, and we will utilize whole genome sequencing, blood transcriptomics, and plasma proteomics to identify distinct genetic, transcriptomic, and proteomic factors influencing the development and progression of COPD. We will also test three high-risk subgroups for rapid COPD progression by selecting 200 subjects from each of three groups hypothesized as high-risk for rapid FEV1 decline (PSE, High COPD Progression Risk Score) and/or increased emphysema (PSE, High Airway Disease Axis Score).

PR150115 (PI: Downey) 10/01/2016–9/30/2019 1.2 calendar
Department of Defense $14,792
Role of Matrix Metalloproteinase-3 in Deployment-Related Pulmonary Fibrosis
Goals: To determine the role of MMP-3 in the pathogenesis of pulmonary fibrosis induced by inhalation of silicate containing particulate matter (PM) and to generate specific inhibitors of MMP-3.

STAGE 2019-0045 (PI: Humphries) 10/01/2018 – 9/30/19 1.8 calendar
University of North Carolina Chapel Hill (subcontract) $63,227
Integration of Trans-omics for Precision Medicine (TOPMED) and Other Heart, Lung, Blood and Sleep (HLBS) Datasets with the Data Commons
Goals: To integrate COPDGene study clinical, genetic, and imaging data into the NIH Data Commons/ STAGE platform and to develop visualization tools for users to search, review, and annotate chest CT images.

1R01HL142049-01A1 (PI: Maier) 7/1/2019 – 6/30/2020 0.36 calendar
NIH/NHLBI $6,463
Novel integrative approaches for disease phenotyping, utilizing radiomics in Sarcoidosis
Goals: To develop reproducible radiomic phenotypes of sarcoidosis in the lung and integrate this signature with clinical data and genetic variants to redefine sarcoidosis phenotyping. As Imaging Scientist, (0.36 calendar) my role is to provide support for quantitative CT analysis.

1R01HL147860-01 (PI: Redente) 2019 – 2024 0.6 months
NIH/NHLBI $8,977
Reducing Fibroblast Persistence in Pulmonary Fibrosis as a Mechanism of Resolution
The goal of this project is to investigate the role of Bcl2 in the apoptosis of pulmonary fibroblasts during a non-resolving model of silica induced pulmonary fibrosis.

Advanced Industries program (PI: Humphries) 2021 – 2023
State of Colorado $35,200
Clinical implementation of an artificial intelligence-based method for lung fibrosis quantitation on CT

External Collaborative Research (ECR) (PI: Humphries) 2021 – 2023
Boehringer Ingelheim $212,345
Analysis of CT scans using deep learning to improve assessment of lung fibrosis

X. BIBLIOGRAPHY

A. PUBLICATIONS IN REFEREED JOURNALS

1. **Humphries SM**, Boyd K, Cornish P, Newman FD. Comparison of Super Stuff and paraffin wax bolus in radiation therapy of irregular surfaces. Medical Dosimetry. 1996 Sep 1;21(3):155-7. PMID: 8899680

2. Rabinovitch R, Finlayson C, Pan Z, Lewin J, **Humphries S**, Biffl W, Franciose R. Radiographic evaluation of surgical clips is better than ultrasound for defining the lumpectomy cavity in breast boost treatment planning: a prospective clinical study. International Journal of Radiation Oncology* Biology* Physics. 2000 May 1;47(2):313-7. PMID: 10802354

3. Berry J, **Humphries S**, O'Malley Jr BW, Staecker H. Making image guidance work: understanding control of accuracy. Annals of Otology, Rhinology & Laryngology. 2003 Aug;112(8):689-92. PMID: 12940666

4. Eckhoff DG, Bach JM, Spitzer VM, Reinig KD, Bagur MM, Baldini TH, Rubinstein D, **Humphries S**. Three-dimensional morphology and kinematics of the distal part of the femur viewed in virtual reality: Part II. JBJS. 2003 Jan 1;85:97-104. PMID: 14652399

5. Christensen AM, **Humphries SM**, Goh KY, Swift D. Advanced "tactile" medical imaging for separation surgeries of conjoined twins. Child's Nervous System. 2004 Aug 1;20(8-9):547-53. PMID: 15278381
6. **Humphries SM**, Hunter KS, Shandas R, Deterding RR, DeBoer EM. Analysis of pediatric airway morphology using statistical shape modeling. Medical & biological engineering & computing. 2016 Jun 1;54(6):899-911. PMID: 26718559

7. Ginsburg SB, Zhao J, **Humphries S**, Jou S, Yagihashi K, Lynch DA, Schroeder JD, COPDGene Investigators. Texture-based quantification of centrilobular emphysema and centrilobular nodularity in longitudinal CT scans of current and former smokers. Academic radiology. 2016 Nov 1;23(11):1349-58. PMID: 27575837

8. Schäfer M, **Humphries SM**, Stenmark KR, Kheyfets VO, Buckner JK, Hunter KS, Fenster BE. 4D-flow cardiac magnetic resonance-derived vorticity is sensitive marker of left ventricular diastolic dysfunction in patients with mild-to-moderate chronic obstructive pulmonary disease. European Heart Journal-Cardiovascular Imaging. 2017 Apr 27;19(4):415-24. PMID: 28460004

9. **Humphries SM**, Yagihashi K, Huckleberry J, Rho BH, Schroeder JD, Strand M, Schwarz MI, Flaherty KR, Kazerooni EA, van Beek EJ, Lynch DA. Idiopathic pulmonary fibrosis: data-driven textural analysis of extent of fibrosis at baseline and 15-month follow-up. Radiology. 2017 May 10;285(1):270-8. PMID: 28493789

10. Redente EF, Aguilar MA, Black BP, Edelman BL, Bahadur AN, **Humphries SM**, Lynch DA, Wollin L, Riches DW. Nintedanib reduces pulmonary fibrosis in a model of rheumatoid arthritis-associated interstitial lung disease. American Journal of Physiology-Lung Cellular and Molecular Physiology. 2018 Mar 15;314(6):L998-1009. PMID: 29543042

11. Lynch DA, Moore CM, Wilson C, Nevrekar D, Jennermann T, **Humphries SM**, Austin JH, Grenier PA, Kauczor HU, Han MK, Regan EA. CT-based visual classification of emphysema: association with mortality in the COPDGene study. Radiology. 2018 May 15;288(3):859-66. PMID: 29762095

12. Mastej EJ, DeBoer EM, **Humphries SM**, Cook MC, Hunter KS, Liptzin DR, Weinman JP, Deterding RR. Lung and airway shape in neuroendocrine cell hyperplasia of infancy. Pediatric radiology. 2018 Nov 1;48(12):1745-54. PMID: 29955904

13. Wu X, Kim GH, Salisbury ML, Barber D, Bartholmai BJ, Brown KK, Conoscenti CS, De Backer J, Flaherty KR, Gruden JF, Hoffman EA, **Humphries SM**, Jacob J, Maher TM, Raghu G, Richeldi L, Ross BD, Schlenker-Herceg R, Sverzellati N, Wells AU, Martinez FJ, Lynch DA, Goldin J, Walsh SLF. Computed Tomographic Biomarkers in Idiopathic Pulmonary Fibrosis. The Future of Quantitative Analysis. American journal of respiratory and critical care medicine. 2019 Jan 1;199(1):12-21. PMID: 29986154

14. **Humphries SM**, Swigris JJ, Brown KK, Strand M, Gong Q, Sundy JS, Raghu G, Schwarz MI, Flaherty KR, Sood R, O'Riordan TG. Quantitative high-resolution computed tomography fibrosis score: performance characteristics in idiopathic pulmonary fibrosis. European Respiratory Journal. 2018 Sep 1;52(3):1801384. PMID: 30139770

15. **Humphries SM**, Notary AM, Centeno JP, Lynch DA. Automatic Classification of Centrilobular Emphysema on CT Using Deep Learning: Comparison with Visual Scoring. In: Image Analysis for Moving Organ, Breast, and Thoracic Images 2018 Aug 16 (pp. 319-325). Springer, Cham.

16. Charbonnier JP, Pompe E, Moore C, **Humphries SM**, van Ginneken B, Make B, Regan E, Crapo JD, van Rikxoort EM, Lynch DA. Airway wall thickening on CT: Relation to smoking status and severity of COPD. Respiratory medicine. 2019 Jan 1;146:36-41. PMID: 30665516

17. Park J, Hobbs BD, Crapo JD, Make BJ, Regan EA, **Humphries SM**, Carey VJ, Lynch DA, Silverman EK, COPDGene Investigators, Subtyping COPD using visual and quantitative CT features, CHEST (2019). PMID: 31283919

18. Regan EA, Lowe KE, Make BJ, Lynch DA, Kinney GL, Budoff MJ, Mao SS, Dyer D, Curtis JL, Bowler RP, Han MK, Beaty TH, Hokanson JE, Kern E, **Humphries SM**, Curran-Everett D, van Beek EJR, Silverman EK, Crapo JD, Finigan JH and the COPDGene investigators. Identifying smoking-related disease on lung cancer screening CT scans: increasing the value. Chronic Obstr Pulm Dis. 2019; 6(3): 233-245. PMID: 31342730

19. Mathai SK, **Humphries SM**, Kropski JA, Blackwell TS, Powers J, Walts AD, Markin C, Woodward J, Chung JH, Brown KK, Steele MP. MUC5B variant is associated with visually and quantitatively detected preclinical pulmonary fibrosis. Thorax. 2019 Dec 1;74(12):1131-9. PMID: 31558622

20. **Humphries SM**, Notary AM, Centeno JP, Strand MJ, Crapo JD, Silverman EK, Lynch DA, Genetic Epidemiology of COPD (COPDGene) Investigators. Deep Learning Enables Automatic Classification of Emphysema Pattern at CT. Radiology. 2019 Dec 3:191022. PMID: 31793851

21. Raghu G, Ley B, Brown KK, Cottin V, Gibson KF, Kaner RJ, Lederer DJ, Noble PW, Song JW, Wells AU, Whelan TP, Lynch DA, **Humphries SM**, Moreau E, Goodman K, Patterson SD, Smith V, Gong Q, Sundy JS, O'Riordan TG, Martinez FJ. Risk factors for disease progression in idiopathic pulmonary fibrosis. Thorax. 2020 Jan 1;75(1):78-80. PMID: 3161134

22. Pompe E, Strand M, van Rikxoort EM, Hoffman EA, Barr RG, Charbonnier JP, **Humphries SM**, Han MK, Hokanson JE, Make BJ, Regan EA. Five-Year Progression of Emphysema and Air Trapping at CT in Smokers with and Those without Chronic Obstructive Pulmonary Disease: Results from the COPDGene Study. Radiology. 2020 Feb 4:191429. PMID: 32013794

23. Salisbury ML, Hewlett JC, Ding G, Markin CR, Douglas K, Mason W, Guttentag A, Phillips III JA, Cogan JD, Reiss S, Mitchell DB, Wu P, Young LR, Lancaster LH, Loyd JE, **Humphries SM**, Lynch DA, Kropski JA, Blackwell TS. Development and progression of radiologic abnormalities in individuals at risk for familial interstitial lung disease. American Journal of Respiratory and Critical Care Medicine. 2020 May 15;201(10):1230-9. PMID: 32011901

24. Walsh SLF, **Humphries SM**, Wells AU, Brown KK. Imaging research in fibrotic lung disease; applying deep learning to unsolved problems. The Lancet Respiratory Medicine. 2020 Feb 25. PMID: 32109428

25. Kirby M, Hatt C, Obuchowski N, **Humphries SM**, Sieren J, Lynch DA, Fain SB, QIBA Lung Density Committee, Fain SB, Lynch DA, Hatt C. Inter-and Intra-software Reproducibility of Computed Tomography Lung Density Measurements. Medical Physics. 2020 Mar 11. PMID: 32160310

26. Schäfer M, Frank BS, **Humphries SM**, Hunter KS, Carmody KL, Jacobsen R, Mitchell MB,

Jaggers J, Stone ML, Morgan GJ, Barker AJ. Flow Profile Characteristics in Fontan Circulation are Associated with the Single Ventricle Dilation and Function: Principal Component Analysis Study. American Journal of Physiology-Heart and Circulatory Physiology. 2020 Mar 13. PMID: 32167782

27. **Humphries SM**, Centeno JP, Notary AM, Gerow J, Cicchetti G, Katial RK, Beswick DM, Ramakrishnan VR, Alam R, Lynch DA. Volumetric assessment of paranasal sinus opacification on computed tomography can be automated using a convolutional neural network. International Forum of Allergy & Rhinology 2020 Apr 19. PMID: 32306522

28. Oh AS, Strand M, Pratte K, Regan EA, **Humphries SM**, Crapo JD, Lynch DA, Genetic Epidemiology of COPDGene Investigators. Visual emphysema at chest CT in GOLD stage 0 cigarette smokers predicts disease progression: results from the COPDGene study. Radiology. 2020 Jul 7:192429. PMID: 32633676

29. Beswick DM, **Humphries SM**, Balkissoon CD, Vladar EK, Ramakrishnan VR, Lynch DA, Taylor-Cousar JL. Machine learning evaluates improvement in sinus computed tomography opacification with CFTR modulator therapy. International Forum of Allergy & Rhinology 2020 Nov 2. PMID: 33140564

30. El Kaddouri B, Strand M, Baragoshi D, **Humphries SM**, Charbonnier JP, van Rikxoort E, Lynch DA. "Fleischner Society Visual Emphysema CT Patterns Predict Progression of Emphysema in current and former smokers: Results from the COPDGene Study", Radiology. 2020 Dec 15:200563. PMID: 33320065

31. Ash SY, San José Estépar R, Fain SB, Tal-Singer R, Stockley RA, Nordenmark LH, Rennard S, Han MK, Merrill D, **Humphries SM**, Diaz AA. Relationship between Emphysema Progression at CT and Mortality in Ever-Smokers: Results from the COPDGene and ECLIPSE Cohorts. Radiology. 2021 Feb 16:203531. PMID: 33591891

32. DeBoer EM, Liptzin DR, **Humphries SM**, Lynch DA, Robison K, Galambos C, Dishop MK, Deterding RR, Weinman JP. Ground Glass and Fibrotic Change in Children with Surfactant Protein C Dysfunction Mutations. Pediatric Pulmonology. 2021 Mar 5. PMID: 33666361

33. Pompe E, Moore CM, Hoesein FA, de Jong PA, Charbonnier JP, Han MK, **Humphries SM**, Hatt CR, Galbán CJ, Silverman K, Crapo JD. Progression of Emphysema and Small Airways Disease in Cigarette Smokers. Chronic Obstructive Pulmonary Diseases: Journal of the COPD Foundation. 2021;8(2):198.

34. Arriaza LR, Massey CJ, **Humphries SM**, Beswick DM, Saavedra MT, Ramakrishnan VR. CFTR-related disorder in an adult with refractory chronic rhinosinusitis: A missed diagnosis and novel mutation. International Forum of Allergy & Rhinology 2021 Apr 6. PMID: 33823074

35. Hatt CR, Oh AS, Obuchowski NA, Charbonnier JP, Lynch DA, **Humphries SM**. Comparison of CT Lung Density Measurements between Standard Full-Dose and Reduced-Dose Protocols. Radiology: Cardiothoracic Imaging. 2021 Apr 22;3(2):e200503. PMID: 33969308

36. Redente EF, Black BP, Backos DS, Bahadur AN, **Humphries SM**, Lynch DA, Tuder RM, Zemans RL, Riches DW. Persistent, progressive pulmonary fibrosis and epithelial remodeling in mice. American Journal of Respiratory Cell and Molecular Biology. 2021 Jun;64(6):669-76. PMID: 33406369

37. Tejwani V, Fawzy A, Putcha N, Castaldi PJ, Cho MH, Pratte KA, Bhatt SP, Lynch DA, **Humphries SM**, Kinney GL, D'Alessio FR, Hansel NN; COPDGene Investigators. Emphysema Progression and Lung Function Decline Among Angiotensin Converting Enzyme Inhibitors and Angiotensin-Receptor Blockade Users in the COPDGene Cohort. Chest. 2021 Oct;160(4):1245-1254. doi: 10.1016/j.chest.2021.05.007. Epub 2021 May 21. PMID: 34029566; PMCID: PMC8546238.

38. Oganesyan A, Hoffner-Heinike A, Barker AJ, Frank BS, Ivy DD, Hunter KS, Mitchell MB, **Humphries SM**, Fenster BE, Schäfer M. Abnormal pulmonary flow is associated with impaired right ventricular coupling in patients with COPD. Int J Cardiovasc Imaging. 2021 Oct;37(10):3039-3048. doi: 10.1007/s10554-021-02285-1. Epub 2021 May 21. PMID: 34021434.

39. Beswick DM, **Humphries SM**, Balkissoon CD, Strand M, E Miller J, Khatiwada A, Vladar EK, Lynch DA, Taylor-Cousar JL. Olfactory dysfunction in people with cystic fibrosis with at least one copy of F508del. Int Forum Allergy Rhinol. 2021 Dec 15. doi: 10.1002/alr.22946. Epub ahead of print. PMID: 34908251.

40. Matson SM, Deane KD, Peljto AL, Bang TJ, Sachs PB, Walts AD, Collora C, Ye S, Demoruelle MK, **Humphries SM**, Schwartz DA. Prospective Identification of Subclinical Interstitial Lung Disease in Rheumatoid Arthritis Cohort is Associated with the MUC5B Promoter Variant. American journal of respiratory and critical care medicine. 2021 Dec 7(ja). PMID: 34874815

41. Beswick DM, **Humphries SM**, Balkissoon CD, Strand M, Vladar EK, Lynch DA, Taylor-Cousar JL. Impact of Cystic Fibrosis Transmembrane Conductance Regulator Therapy on Chronic Rhinosinusitis and Health Status: Deep Learning CT Analysis and Patient-reported Outcomes. Annals of the American Thoracic Society. 2022 Jan;19(1):12-9. PMID: 34436985

42. Klont F, Horvatovich P, Bowler RP, van Rikxoort E, Charbonnier JP, Kwiatkowski M, Lynch DA, **Humphries S**M, Bischoff R, Ten Hacken NHT, Pouwels SD. Plasma sRAGE levels strongly associate with centrilobular emphysema assessed by HRCT scans. Respir Res. 2022 Jan 24;23(1):15. doi: 10.1186/s12931-022-01934-w. PMID: 35073932; PMCID: PMC8785488.

43. Beswick DM, **Humphries SM**, Balkissoon CD, Strand M, Vladar EK, Ramakrishnan VR, Taylor-Cousar JL. Olfactory dysfunction in cystic fibrosis: Impact of CFTR modulator therapy. J Cyst Fibros. 2022 Mar;21(2):e141-e147. doi: 10.1016/j.jcf.2021.09.014. Epub 2021 Sep 29. PMID: 34598881.

44. Zell-Baran LM, **Humphries SM**, Moore CM, Lynch DA, Charbonnier JP, Oh AS, Rose CS. Quantitative imaging analysis detects subtle airway abnormalities in symptomatic military deployers. BMC Pulm Med. 2022 Apr 27;22(1):163. doi: 10.1186/s12890-022-01960-w. PMID: 35477425; PMCID: PMC9047334.

45. Oh AS, Baraghoshi D, Lynch DA, Ash SY, Crapo JD, **Humphries SM**; COPDGene Investigators. Emphysema Progression at CT by Deep Learning Predicts Functional Impairment and Mortality: Results from the COPDGene Study. Radiology. 2022 Sep;304(3):672-679. doi: 10.1148/radiol.213054. Epub 2022 May 17. PMID: 35579519; PMCID: PMC9434819.

46. Beswick DM, **Humphries SM**, Miller JE, Balkissoon CD, Khatiwada A, Vladar EK, Ramakrishnan VR, Lynch DA, Taylor-Cousar JL. Objective and patient-based measures of chronic rhinosinusitis in people with cystic fibrosis treated with highly effective modulator therapy. Int Forum Allergy Rhinol. 2022 Nov;12(11):1435-1438. doi: 10.1002/alr.23016. Epub 2022 May 20. PMID: 35595546.

47. Walsh SL, Mackintosh JA, Calandriello L, Silva M, Sverzellati N, Larici AR, **Humphries SM**, Lynch DA, Jo HE, Glaspole I, Grainge C, Goh N, Hopkins PMA, Moodley Y, Reynolds PN, Zappala C, Keir G, Cooper WA, Mahar AM, Ellis S, Wells AU, Corte TJ. Deep Learning-based Outcome Prediction in Progressive Fibrotic Lung Disease Using High-resolution Computed Tomography. Am J Respir Crit Care Med. 2022 Jun 13. doi: 10.1164/rccm.202112-2684OC. Epub ahead of print. PMID: 35696341.

48. Choi B, Adan N, Doyle TJ, San José Estépar R, Harmouche R, **Humphries SM**, Moll M, Cho MH, Putman RK, Hunninghake GM, Kalhan R, Liu GY, Diaz AA, Mason SE, Rahaghi FN, Pistenmaa CL, Enzer N, Poynton C, Sánchez-Ferrero GV, Ross JC, Lynch DA, Martinez FJ, Han MK, Bowler RP, Wilson DO, Rosas IO, Washko GR, San José Estépar R, Ash SY; COPDGene Study and Pittsburgh Lung Screening Study Investigators. Quantitative Interstitial Abnormality Progression and Outcomes in the COPDGene and PLuSS Cohorts. Chest. 2022 Jun 30:S0012-3692(22)01202-8. doi: 10.1016/j.chest.2022.06.030. Epub ahead of print. PMID: 35780812.

49. Bhatt SP, Bodduluri S, Dransfield MT, Reinhardt JM, Crapo JD, Silverman EK, **Humphries SM**, Lynch DA, Strand MJ. Acute Exacerbations Are Associated with Progression of Emphysema. Ann Am Thorac Soc. 2022 Aug 1. doi: 10.1513/AnnalsATS.202112-1385RL. Epub ahead of print. PMID: 35914221.

50. Bhatt SP, Bodduluri S, Nakhmani A, Kim YI, Reinhardt JM, Hoffman EA, Motahari A, Wilson CG, **Humphries SM**, Regan EA, DeMeo DL. Sex Differences in Airways at Chest CT: Results from the COPDGene Cohort. Radiology. 2022 Aug 2:212985. doi: 10.1148/radiol.212985. Epub ahead of print. PMID: 35916677.

51. **Humphries SM**, Mackintosh JA, Jo HE, Walsh SLF, Silva M, Calandriello L, Chapman S, Ellis S, Glaspole I, Goh N, Grainge C, Hopkins PMA, Keir GJ, Moodley Y, Reynolds PN, Walters EH, Baraghoshi D, Wells AU, Lynch DA, Corte TJ. Quantitative computed tomography predicts outcomes in idiopathic pulmonary fibrosis. Respirology. 2022 Jul 25. doi: 10.1111/resp.14333. Epub ahead of print. PMID: 35875881.

52. Massey CJ, Ramos L, Beswick DM, Ramakrishnan VR and **Humphries SM**. Clinical Validation and Extension of an Automated, Deep Learning–Based Algorithm for Quantitative Sinus CT Analysis. American Journal of Neuroradiology September 2022, 43 (9) 1318-1324.

53. Steele MP, Peljto AL, Mathai SK, **Humphries SM**, Bang TJ, Oh A, Teague S, Cicchetti G, Sigakis C, Kropski JA, Loyd JE, Blackwell TS, Brown KK, Schwarz MI, Warren RA, Powers J, Walts AD, Markin C, Fingerlin TE, Yang IV, Lynch DA, Lee JS, Schwartz DA. Incidence and Progression of Fibrotic Lung Disease in an At-Risk Cohort. Am J Respir Crit Care Med. 2022 Sep 12. doi: 10.1164/rccm.202206-1075OC. Epub ahead of print. PMID: 36094461.

54. Denton CP, Goh NS, **Humphries SM**, Maher TM, Spiera R, Devaraj A, Ho L, Stock C, Erhardt

E, Alves M, Wells AU; SENSCIS trial investigators. Extent of fibrosis and lung function decline in patients with systemic sclerosis and interstitial lung disease: data from the SENSCIS trial. Rheumatology (Oxford). 2022 Sep 16:keac535. doi: 10.1093/rheumatology/keac535. Epub ahead of print. PMID: 36111858.

B. MANUSCRIPTS IN REVIEW

1. Baraghoshi D, Strand M, Humphries SM, Estepar RSJ, Vegas Sanchez-Ferrero G, Charbonnier JP, Latisenko R, Silverman E, Lynch DA, CT evaluation of emphysema progression over 10 years in the COPDGene study (in review).

C. OTHER PUBLICATIONS

1. Lodwick W, Newman FD, McCourt SL, **Humphries SM**: "Optimization methods for radiation therapy plans", in: Computational Radiology and Imaging: Therapy and Diagnostics, The IMA Volumes in Mathematics and its Applications Vol. 110, Springer-Verlag, 1998.

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3. Hayes KL, Weinman J, **Humphries SM**, Rubenstein D, Koons ML: "Evolution of Paleoradiology in Colorado: The Experience of Two Egyptian Mummies", in: Koons ML, MacLeod CA. The Egyptian Mummies and Coffins of the Denver Museum of Nature & Science: History, Technical Analysis, and Conservation. University Press of Colorado; 2021.

D. PRESENTATIONS AT NATIONAL AND INTERNATIONAL MEETINGS

1. **Humphries SM**, Cline HJ, Newman FD: "Evaluation of portal images using artificial neural networks", Fourth International Workshop on Electronic Portal Imaging, June 1996, Amsterdam, The Netherlands (oral).
2. Mutic S, **Humphries SM**, Brown M, Newman FD: "Verification of a commercially available linac-based stereotactic radiosurgery system using a BANG-2 polymer gel dosimeter and MRI", 38th Meeting of the American Association of Physicists in Medicine, July 1996, Philadelphia, PA (oral).
3. Humphries SM, Taylor D, Cline HJ, and Newman FD: "Evaluation of portal images using a counterpropagation neural network", 39th Meeting of the American Association of Physicists in Medicine, July 1997, Milwaukee, WI (oral).
4. **Humphries SM**, Koss JE, Hibbard JS, and Newman FD: "A multi-architecture, connectionist approach to automated segmentation of CT images for radiotherapy planning", 39th Meeting of the American Association of Physicists in Medicine, July 1997, Milwaukee, WI (oral).
5. Newman FD, Holder A, **Humphries SM**, McCourt SL: "A Robust linear programming approach to the optimal placement and intensity of radiotherapy beams in the treatment of benign and malignant lesions", International Symposium on Mathematical Programming, August 1997,

Lausanne, Switzerland (oral).

6. Newman FD, Tollenaar B, McCourt SL, **Humphries SM**: "Clinical Implementation of an inverse planning system", CMS Users' Symposium, St. Louis, MO, April 1998 (oral).
7. Rabinovitch RA, **Humphries SM**, et al: "Superiority of radio-opaque clips compared to ultrasound as methods of defining lumpectomy cavity volumes for breast boost planning", 40th Meeting of the American Association for Therapeutic Radiology and Oncology, 1998 (oral).
8. Newman FD, **Humphries SM**, et al: "A multi resolution global optimization scheme applied to active contours for edge finding in medical images", Meeting of the Society for Industrial and Applied Mathematics, May, 1999 (oral).
9. Staecker H, O'Malley B, **Humphries SM**, Berry J: "Effect of fiducial placement on accuracy of image-guided surgery", Amer Acad Otolaryng Surg, 2002 (oral).
10. Eckhoff DG, Bach JM, Baldini TH, Spitzer VM, Reinig KD, Bagur MM, **Humphries SM**, Flannery NP: "3D Morphology and Kinematics of the Distal Femur Viewed in Virtual Reality", 70th Annual Meeting of the American Academy of Orthopedic Surgeons, February 2003 (oral).
11. **Humphries SM** and Christensen AM: "Use of 3D Printed Anatomical Phantoms with Image Guidance for Training and Surgical Rehearsal", Computer Assisted Radiology, Chicago, 2004 (poster).
12. **Humphries, SM**: "Co-Registration of Multi-Modal Image Data for Development of Complex 3D Printed anatomical models", 2nd International Conference on Advanced Digital Technologies for Head and Neck Reconstruction, 2005 (oral).
13. **Humphries SM**, Christensen AM, Bradrick JP: "Cone Beam Versus Conventional CT: Comparative Analysis of Image Data and Segmented Surface Models", 12th Computed Maxillofacial Imaging Congress, 2006 (oral).
14. **Humphries SM**, Taylor DD: "CyberKnife Mechanical Accuracy Measured With An Optical Tracking System: Characterization Of Method And Initial Results", CyberKnife Users' Group Meeting 2007, Palm Springs, CA (oral).
15. **Humphries SM**, Taylor DD: "A Novel Technique to Measure Motion Tracking Accuracy in Robotic Radiosurgery", Congress of the International Stereotactic Radiosurgery Society, Seoul, South Korea, June 2009 (oral).
16. DeBoer E, **Humphries SM**, Shandas R, Deterding R: "Variance of Airway Size and Angle Measured on CT of Normal Children", American Thoracic Society, San Francisco, May 2012 (poster).
17. **Humphries SM**, DeBoer E, Hunter K, Shandas R, Deterding R: "Analysis of Pediatric Airway Morphology Using Statistical Shape Modeling", American Thoracic Society, Philadelphia, PA, May 2013 (poster).
18. DeBoer E, Deterding R, **Humphries SM**: "Do Children With CF Have Airways Shaped Differently Than Other Children Based on CT?", North American Cystic Fibrosis Conference, Salt Lake City, UT, October 2013 (poster).
19. **Humphries SM**, Yagihashi K, Schroeder J, Hunter K, Lynch D: "Classification of Usual Interstitial Pneumonia Pattern on Computed Tomography using a Novel Combination of Image Texture Descriptors", Pulmonary Fibrosis Foundation Summit, La Jolla, CA, December 2013 (poster).
20. **Humphries SM**, Yagihashi K, Schroeder J, Huckleberry J, Sood R, Hunter K, Lynch D: "Volumetric Quantification of Usual Interstitial Pneumonia Pattern on Computed Tomography using Spin Image Texture Descriptors", American Thoracic Society, San Diego, CA, May 2014 (poster).
21. **Humphries SM**, Yagihashi K, Sood R, Schroeder J, Rho BH, Lynch D: "Quantification of IPF on Chest CT using Unsupervised Feature Learning", American Thoracic Society, Denver, CO,

May 2015 (poster).

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23. Yagihashi K, Lynch D, Huckleberry J, Zach J, **Humphries SM**, Yow E, Flaherty KR, Tschirren J, van Beek EJ, Kazerooni E, Anstrom K, Schwarz ML, and the IPFNet Investigators: "Quantitative CT Analysis and Survival in Idiopathic Pulmonary Fibrosis", American Thoracic Society, Denver, CO, May 2015 (oral).
24. Charbonnier JP, Lynch DA, **Humphries SM**, Strand M, van Rikxoort E: "Relative contributions of quantitative CT measures to airflow obstruction in cigarette smokers", American Thoracic Society, San Francisco, CA, May 2016 (poster).
25. van Rikxoort E, Strand M, **Humphries SM**, Lynch DA: "Progression of CT quantified lung density in the COPDGene study and its relationship to spirometry", American Thoracic Society, San Francisco, CA, May 2016 (poster).
26. **Humphries SM**, O'Riordan T, Zhang J, Bayly S, Sood R, Hayden A, Lynch DA: "Relationships between baseline quantitative fibrosis score to lung function in a clinical trial population with idiopathic pulmonary fibrosis", American Thoracic Society, San Francisco, CA, May 2016 (poster).
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28. **Humphries SM**, Rodriguez A, Chen-Mayer HH, Fuld MK, Hoppel BE, Sieren JP, Judy PF, Crotty D, Fain SB, Lynch DA, for the QIBA/RSNA Lung Density Biomarker Committee, "QIBA Lung Density Biomarker Committee: Harmonization CT Density Measures Across Platforms", Radiological Society of North America, Chicago, Dec 2016 (poster).
29. Charbonnier JP, Han MK, Pompe E, Moore C, **Humphries SM**, Lynch DA, van Ginneken B, Make B, van Rikxoort E, "CT-Based Models for Prediction of Chronic Obstructed Pulmonary Disease and Smoking-related Morbidity in Cigarette Smokers", Radiological Society of North America, Chicago, Dec 2016 (oral).
30. **Humphries SM**, O'Riordan TG, Sundy JS, Zhang JJ, Gong Q, Bayly S, Sood R, Raghu G, Lynch DA, "Change in CT-derived Fibrosis Score Correlates with Lung Function Progression in a Clinical Trial Population with Idiopathic Pulmonary Fibrosis", American Thoracic Society, Washington, DC, 2017 (poster).
31. **Humphries SM**, Notary A, Hatt CR, Han MK, Lynch DA, "Quantitative measures of emphysema derived from reduced dose CT protocols: comparison with higher dose protocol", American Thoracic Society, Washington, DC, 2017 (poster).
32. Mastej E, **Humphries SM**, DeBoer E, "Automated Airway Scores of Bronchiectasis in Children with CF Using a Machine Learning Classifier", American Thoracic Society, Washington, DC, 2017 (poster).
33. Raghu G, Brown K, Cottin V, Gibson K, **Humphries SM**, Kaner R, Lederer D, Lynch D, Noble P, Song J, Wells A, Whelan T, Patterson S, Smith V, Goodman K, Gong Q, Zhang J, Sundy J, O'Riordan T, Martinez F, "Risk Factors for Disease Progression in a Clinical Trial Population with Idiopathic Pulmonary Fibrosis", American Thoracic Society, Washington, DC, 2017 (poster).
34. Lynch DA, Moore C, Wilson CG, Nevrekar DV, Jennermann TB, **Humphries SM**, Austin JH, Grenier PA, Kauczor HU, Han MK, Regan E, Make BJ, Bowler R, Beaty T, Everett DC, Hokanson J, Curtis J, Silverman EK, Crapo JD. "Visual Emphysema Pattern Using the

Fleischner Society Classification System is Independently Associated with Mortality in Cigarette Smokers", Radiological Society of North America, Chicago, Dec 2017 (oral).

35. **Humphries SM**, Rodriguez A, Chen-Mayer HH, Fuld MK, Hoppel BE, Sieren JP, Judy PF, Crotty D, Fain SB, Lynch DA, for the QIBA/RSNA Lung Density Biomarker Committee, "QIBA Lung Density Biomarker Committee: Progress and Activities", Radiological Society of North America, Chicago, Dec 2017 (poster).
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37. Mastej E, **Humphries SM**, Cook M, Liptzin D, Weinman J, Deterding RR, DeBoer EM, "Lung Shape from Chest Computed Tomography Scan Predicts Diagnosis of Neuroendocrine Cell Hyperplasia of Infancy", American Thoracic Society 2018, San Diego, CA (poster).
38. Crossley D, **Humphries SM**, Stockley RA, Turner AM, "Comparison of Pulmonary CT Density Analysis Between Two Leading Software Programs", American Thoracic Society 2018, San Diego, CA (poster).
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43. **Humphries SM**, AM Notary, JP Centeno, DA Lynch, for the TRAIL Investigators: "Use of Quantitative CT to Determine Disease Extent and Identify UIP Pattern in Rheumatoid Arthritis ILD". American Thoracic Society 2019, Dallas, TX (poster).
44. L Gallardo Estrella, SP Bhatt, EM van Rikxoort, **Humphries SM**, E Pompe, DA Lynch, JP Charbonnier: "A Novel Method for Quantification of Expiratory Airtrapping Independent of Expiration Level". American Thoracic Society 2019, Dallas, TX (poster).
45. Lowe K, C Thiele, EL Port, C Wilson, **Humphries SM**, DA Lynch, H Lindsey, JD Crapo, EK Silverman, JH Finigan, EA Regan: "Osteoporosis, Coronary Artery Calcification, and Chronic Obstructive Pulmonary Disease (COPD) in a Lung Cancer Screening Cohort". American Thoracic Society 2019, Dallas, TX (poster).
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48. JC Hewlett, G Ding, M Salisbury, **Humphries SM**, C Markin, DB Mitchell, S Reiss, LR Young, JE Loyd, JA Phillips, JA Worrell, A Guttentag, DA Lynch, JD Cogan, TS Blackwell, JA Kropski: "The prevalence and progression of early interstitial lung disease in first-degree

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55. Solomon J, Amigues I, Bang T, Teague SD, Lynch DA, Swigris JJ, **Humphries SM**. Quantitative Computed Tomography Analysis in Rheumatoid Arthritis-Related Interstitial Lung Disease (RA-ILD). InD44. AUTOIMMUNE AND DRUG INDUCED LUNG DISEASE 2020 May (pp. A6827-A6827). American Thoracic Society 2020.
56. Latisenko R, **Humphries SM**, Gallardo Estrella L, van Rikxoort EM, Lynch DA, Charbonnier JP. Deep Learning to Reduce Dose-Introduced Variation in CT Quantified Emphysema: Cross-Sectional and Longitudinal Analysis in COPDGene. InA66. A SHARPER IMAGE: NOVEL IMAGING METHODOLOGIES 2020 May (pp. A2333-A2333). American Thoracic Society.
57. **Humphries SM**, "Description of Quantitative and Semi-Quantitative Imaging in Parenchymal Lung Diseases", In: Imaging - March of the Machines: Integration of Artificial Intelligence Algorithms in Pulmonary Imaging, Chest 2020 (virtual meeting).
58. D Beswick, **SM Humphries**, C Balkissoon, M Strand, E Vladar, V Ramakrishnan, D Lynch, J Taylor-Cousar. Olfactory dysfunction: impact of highly effective modulator therapy, 44th European Cystic Fibrosis Conference, 2021.
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Arteries, Airways and Parenchymal Fibrosis as Indicators of Disease Severity and Progression in Idiopathic Pulmonary Fibrosis. American Thoracic Society, 2021.

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66. AJ Bell, S Ram, WW Labaki, S Murray, E Kazerooni, S Galban, DA Lynch, **SM Humphries**, FJ Martinez, CR Hatt, MK Han, CJ Galban. Topological Parametric Response Mapping (PRM) Analysis for Spatially Localized Parenchymal Characterization in COPD: A COPDGene Study. American Thoracic Society, 2021.
67. Oh AS, Ash SY, Lynch DA, **Humphries SM**. "Progression in Deep Learning Emphysema Grade Predicts Disease Progression and Mortality", ATS 2022.
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70. Oh AS, Lynch DA, Flaherty KR, **Humphries SM**. "Visual and Quantitative CT Derived Parameters Predict Transplant-Free Survival in Patients with Interstitial Lung Disease: Results from the Pulmonary Fibrosis Foundation Registry", ATS 2022.
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XI. INTERACTION WITH INDUSTRY

Service contracts: Parexel International, Calyx, Boehringer Ingelheim, Gilead Sciences, Astra Zeneca, Nitto Pharma, Taiho, Celgene and Kadmon
Research grants: Veracyte and Boehringer Ingelheim
Advisory board: Boehringer Ingelheim, Veracyte, Lyra Therapeutics, IMIDEX LLC