Washington State Health Care Authority

June 23, 2023 Meeting Materials
Health Technology Clinical Committee

Stereotactic body radiation therapy

Contents

Personal Data

Name: Simon S. Lo, M.B., Ch.B., FACR, FASTRO

Address:

Telephone number:

Place of birth:

Citizenship:

Date of birth:

Email:

Education

M.B., Ch.B. (M.D. equivalent)
Faculty of Medicine
Chinese University of Hong Kong
Shatin, New Territories
Hong Kong
Studies completed: June 1991
Date conferred: December 1991
Medical degree fully accredited by General Medical Council, UK with no examination required
(US News & World Report Top Clinical Medicine Universities in the World 2020: Ranked no. 92)
https://www.usnews.com/education/best-global-universities/clinical-medicine
(QS World University Rankings® 2020: Ranked no. 43)
https://www.topuniversities.com/university-rankings/university-subject-rankings/2020/medicine

Postgraduate Training

Training Position	Department	Institution	Date
Intern	Obstetrics and Gynaecology, Surgery, Medicine and Paediatrics	Prince of Wales Hospital, Hong Kong SAR, China	July 1, 1991-June 30, 1992
Resident	Orthopaedics	Kwong Wah Hospital, Hong Kong SAR, China	July 1, 1992-June 30, 1993
Resident	Clinical Oncology (Royal College of Radiologists, UK curriculum and also eligible for FRCP Canada Board Examination)	Queen Elizabeth Hospital, Hong Kong SAR, China	July 1, 1993-May 31, 1997
Resident	Radiation Oncology	University of Minnesota Medical Center, Minneapolis, MN	July 1, 1997-June 30, 2001

American College of Radiation Oncology Fellow in Gastrointestinal Radiation Oncology and IORT (funded by grant)- Away rotation during residency	Radiation Oncology	Mayo Clinic, Rochester, MN	July 1-August 31, 2000
Visiting Fellow (Observer)- Away rotation during residency	Radiation Oncology	Princess Margaret Cancer Centre, University of Toronto, Toronto, ON, Canada	January 1-31, 2001

Faculty Positions Held

Faculty Position	Department	Institution	Date
Assistant Professor of Radiation Oncology	Radiation Oncology	Wayne State University School of Medicine, Detroit, MI	July 1, 2001- June 30, 2002
Assistant Professor of Radiation Oncology	Radiation Oncology	Loyola University Chicago, Maywood, IL	July 15, 2002- June 30, 2004
Assistant Professor of Radiation Oncology	Radiation Oncology	Indiana University School of Medicine, Indianapolis, IN	July 1, 2004- June 23, 2006
Associate Professor of Radiation Oncology	Radiation Oncology	The Ohio State University College of Medicine, Columbus, OH	June 26, 2006- February 28, 2011
Associate Professor of Neurosurgery (Adjunct appointment)	Neurosurgery	The Ohio State University College of Medicine, Columbus, OH	June 26, 2006- February 28, 2011
Visiting Associate Professor of Radiation Oncology	Radiation Oncology	Case Western Reserve University School of Medicine, Cleveland, OH	March 1, 2011- June 30, 2011
Associate Professor of Radiation Oncology	Radiation Oncology	Case Western Reserve University School of Medicine, Cleveland, OH	July 1, 2011-June 30, 2015
Professor of Radiation Oncology	Radiation Oncology	Case Western Reserve University School of Medicine, Cleveland, OH	July 1, 2015-July 22, 2016
Professor and Vice-Chair for Strategic Planning	Radiation Oncology	University of Washington School of Medicine	August 1, 2016- Present

Professor of Neurological Surgery	Neurological Surgery	University of Washington School of Medicine	August 1, 2016-Present

Hospital Positions Held

Faculty Position	Department	Institution	Date
Attending Radiation Oncologist	Radiation Oncology	Barbara Ann Karmanos Cancer Institute, Detroit, MI	July 1, 2001- June 30, 2002
Attending Radiation Oncologist	Radiation Oncology	Loyola University Medical Center, Maywood, IL	July 15, 2002- June 30, 2004
Director, Medical Student Elective Rotation	Radiation Oncology	Loyola University Medical Center, Loyola University Chicago, Maywood, IL	November 1, 2002-June 30, 2004
Attending Radiation Oncologist	Radiation Oncology	Indiana University Cancer Center, Indianapolis, IN	July 1, 2004- June 23, 2006
Medical Director	Radiation Oncology	Richard L Roudebush VA Medical Center, Indianapolis, IN	July 1, 2004-November 30, 2004
Attending Radiation Oncologist	Radiation Oncology	Arthur G. James Cancer Hospital, Columbus, OH	June 26, 2006-February 28, 2011
Residency Program Director	Radiation Oncology	Arthur G. James Cancer Hospital, The Ohio State University College of Medicine, Columbus, OH	August 1, 2006-July 31, 2009
Director of Neurologic Radiation Oncology and Stereotactic Radiosurgery	Radiation Oncology	Arthur G. James Cancer Hospital, The Ohio State University College of Medicine, Columbus, OH	June 26, 2006-March 31, 2009
Director of Stereotactic Body Radiotherapy	Radiation Oncology	Arthur G. James Cancer Hospital, The Ohio State University College of Medicine, Columbus, OH	June 26, 2006-February 28, 2011
Director of Neurologic Radiation Oncology and Gamma Knife Radiosurgery	Radiation Oncology	University Hospitals Seidman Cancer Center, Cleveland, OH	March 1, 2011-July 22, 2016
Director of Radiosurgery Services (Medical service	Radiation Oncology	University Hospitals Seidman Cancer Center, Cleveland, OH	January 1, 2012-July 22, 2016

agreement with cancer center)			
Attending Radiation Oncologist	Radiation Oncology	University Hospitals Seidman Cancer Center, Cleveland, OH	March 1, 2011-July 22, 2016
Attending Radiation Oncologist	Radiation Oncology	University of Washington Medical Center/ Seattle Cancer Care Alliance (SCCA)	August 1, 2016-Present
Courtesy Attending Physician	Neurological Surgery	Harborview Medical Center, Seattle, WA	August 1, 2016-Present
Attending Radiation Oncologist	Radiation Oncology	Seattle Proton Therapy Center	August 1, 2019-Present
Director of SBRT	Radiation Oncology	University of Washington	February 2018-Present

UW Medicine/ Fred Hutchinson Cancer Research Center Positions Held

Position	Committee	Institution	Date
Member	Credential Committee	UWMC	September 2016-Present
Key personnel	Leading Academic Participating Site, NCTN	Fred Hutchinson Cancer Research Center	March 1, 2019-February 29, 2020
Member of Leadership Team	Leading Academic Participating Site, NCTN	Fred Hutchinson Cancer Research Center	March 1, 2020-Present

Department Positions Held

Position	Committee	Institution	Date
Co-Chair	Appointment and Promotion Committee	UW SOM	2018-Present
Member	Clinical Trial Committee	UW Rad Onc	2020-Present

Honors

Honor/ Award	Year
Berlex Oncology Foundation: Epidemiology and Clinical Trial Design (Training Workshop)	1998
Berlex Oncology Foundation: Clinical Pharmacology of Anticancer Agents (Training Workshop)	1999
American College of Radiation Oncology Fellowship Grant Award in Gastrointestinal Oncology	2000
Radiological Society of North America Roentgen Resident/ Fellow Research Award	2001

Teacher Of The Year Award, Department of Radiation Oncology, Wayne State University- Elected by the residents in the residency program	2002
Excellence in Teaching Award, Department of Radiation Medicine, The Ohio State University College of Medicine	2008
Listed in Marquis Who's Who in America	2011
Awardee for Fellowship of American College of Radiology (FACR)	2014
Outstanding Reviewer of the Year, International Journal of Radiation Oncology, Biology, and Physics	2014
Outstanding Reviewer of the Year, Radiotherapy and Oncology	2015
Association of Residents in Radiation Oncology (ARRO) Educator of the Year	2014-2015
Best Doctors, Inc	2015-2020
Cleveland Magazine, Top Doctor	2015, 2016
Top Doctor, Castle Connolly	2013-2022
Seattle Magazine, Top Doctor	2020, 2021
Faculty Mentor of the Year, Association of Residents and Fellows, University Hospitals Case Medical Center	2016
Awardee for Fellowship of American Society for Radiation Oncology (FASTRO)	2017
Nominee for Board of Trustees of American Board of Radiology	2017, 2018, 2019
Elected Member of Board of Directors, Radiosurgery Society	2019-2025 (Re-elected in 2022)
American College of Radiology (ACR) Chapter Recognition Award for Membership to CARROS (Radiation Oncology Chapter of ACR)- Co-leader for the award application	2019, 2020
Society for Palliative Radiation Oncology Lifetime Achievement Award	2019
UW Radiation Oncology Residency Teaching Award	2019

Board Certification

USMLE steps 1, 2 and 3 passed in 1994, 1995, and 1999
ECFMG certified in 1993

Eligible for Royal College of Radiologists, UK Fellowship Examination in Clinical Oncology
Certified by American Board of Radiology in Radiation Oncology in June 2001 (Passed written and oral examinations in September 2000 and June 2001, respectively on first attempt)
ABR (Written boards- September 2000):
96th percentile for Clinical Oncology (1st quartile for all 8 areas)

92th percentile for Radiation Physics
89th percentile for Radiobiology

Recertified May 2011 (Good through December 2021)

Basic Life Support re-certified August 2021 (valid till August 2023)

Advanced Cardiac Life Support certified in August 2016 (valid until August 2020)

Cleveland Clinic Foundation Gamma Knife ICON training
October 25-27, 2017

Current License(s) to Practice:

Full registration, General Medical Council, UK, August 1993-Present
Unrestricted Minnesota medical license granted in November 1999 (active)
Unrestricted Michigan medical license granted in March 2001 (active)
Unrestricted Indiana medical license granted in December 2004 (active)
Unrestricted Ohio medical license granted in April 2006 (active)
Unrestricted Washington medical license granted in March 2016 (active)

Diversity, Equity and Inclusion Activities (optional): None

Professional Organizations

Service on professional societies:

1.American Society for Therapeutic Radiology and Oncology (ASTRO):

Member of the Publications Committee of the Education Council
2007-2011
Member of the Workforce Diversity Subcommittee of the Research Council
2008-2014
Member of Emerging Technology Committee
2013-2015
Member (Recognized expert) of the ASTRO brain metastasis guidelines taskforce
2010-2011
Member (Recognized expert) of the ASTRO bone metastasis guidelines taskforce (Responsible for drafting the guidelines for stereotactic body radiation therapy for spinal metastases together with Dr. Eric L. Chang from M.D. Anderson Cancer Center and Dr. Arjun Sahgal from University of Toronto, Canada)
2010-2011
Member of ASTRO bone metastasis guidelines work group (responsible for updating of current guidelines)
2014-2016
Member of ASTRO Guideline Subcommittee
2014-Present
Panelist of ASTRO guidelines for stereotactic body radiation therapy for lung cancer (Invited)
2015-Present
Member of ASTRO Payer Relations Subcommittee
2015-Present
Member of ASTRO CNS Committee
2013-2016, 2019-Present

Abstract Reviewer for CNS tumors
2013-2017, 2019-Present
Abstract Reviewer for Palliative Radiation Oncology
2019-Present
SBRT Model Policy Work Group
2019-Present
Member of ASTRO Science Education and Program Development Subcommittee
2019-Present
Member of ASTRO Education Committee
2019-Present
SRS Model Policy Work Group
2020-Present

2. Radiological Society of North America (RSNA):

Member of the Subcommittee in Radiation Oncology & Radiobiology, Committee for the RSNA Scientific Assembly
April 2010-November 2013

Abstract Reviewer
November 2009-November 2013

Refresher Course Radiation Oncology Track Chair
November 2014-December 2019

Member of Oncologic Imaging and Therapies Task Force
November 2014-December 2019

Member of AMPPC Subcommittee
2020-Present

3. International Consensus Conference:

Panel Member of International Consensus Conference Bone Metastasis Group
2009-2011
Panel Member of International Consensus Conference Brain Metastasis Group
2009-2011

4. American College of Radiology:

Vice-Chair and Panel Member, June 1, 2009-May 31, 2012
Panel Chair, Starting June 1, 2012-May 31, 2017
American College of Radiology Appropriateness Criteria® Expert Panel on Radiation Oncology-Bone Metastases

Panel Member, June 1, 2013-May 31, 2017
American College of Radiology Appropriateness Criteria® Expert Panel on Radiation Oncology-Brain Metastases

Radiation Oncology Representative, February 1, 2017-May 31, 2019
American College of Radiology Appropriateness Criteria® Neuro 2 Expert Panel
ACR AC Management of Vertebral Compression Fractures document

Radiation Oncology Representative, June 1, 2019-Present
American College of Radiology Appropriateness Criteria® Expert Panel on Urological Imaging

ACR AC Post-Treatment Follow-up and Active Surveillance of Clinically Localized Renal Cell Cancer document

Chair, Program Committee
Council of Affiliated Regional Radiation Oncology Societies (CARROS)
January 2012-2014
Comments: Responsible for development of in informational sessions for the CARROS program before ASTRO every year

Secretary, Executive Committee
Council of Affiliated Regional Radiation Oncology Societies (CARROS)
January 2015-September 2016

President-Elect
Council of Affiliated Regional Radiation Oncology Societies (CARROS)
September 2016-2018

President
Council of Affiliated Regional Radiation Oncology Societies (CARROS)
September 2018-2020

Immediate Past President and Fellowship Committee Chair
Council of Affiliated Regional Radiation Oncology Societies (CARROS)
September 2020-October 2022

Member
ACR Radiation Oncology Commission
2018-2020

Contributor of questions in pediatric and CNS radiation oncology and medical statistics in the American College of Radiology in-training examination
2006-2014

Member
Population Health Management (PHM) Committee for the Patient- and Family-Centered Care (PFCC) Commission
May 2018-Present

Member
ACR Practice Parameters Committee (2022-Present)

Chair
ACR Practice Parameters for Radiation Oncology (2022)

5. Radiation Therapy Oncology Group

Member, Symptom Management Committee
March 2012-June 2014

6. NRG Oncology

Member, Cancer Prevention and Control Steering Committee
June 2014-Present

Disease site liaison, Functional/Quantitative Imaging Working Group

July 2014-Present

Liaison to the NRG Oncology Lung Steering Committee
September 2016-Present

7. Leksell Gamma Knife Society

Leksell Society Gamma Knife Meetings 2012-2017
Abstract Reviewer

8. Elekta International Oligometastasis Consortium

Core Member
October 2013-March 2016

Lead for international survey/ consensus guidelines project

9. Radiosurgery Society (RSS)

Member, RSS Meeting Planning Committee
2016-Present

Volunteer, Webinar Development
2015-Present

National Medical Director for Distinction in Practice in SRT Accreditation Program
2017-Present

Board of Directors
4/1/2019-Present

10. American Radium Society

Chair, Bone Metastasis Panel, ACR-ARS Appropriate Use Committee
May 2017-May 2020
Consultant, Bone Metastasis Panel, ACR-ARS Appropriate Use Committee
May 2020-Present

Member, Brain Metastasis Panel, ACR-ARS Appropriate Use Committee
May 2017-Present

11. ICON Gamma Knife Expert Group

Member
September 2017- Present

12. American Society of Clinical Oncology

Member, Annual Meeting Education Committee - Central Nervous System Tumors
June 2018-Present

13. American College of Radiation Oncology

Member, Development Committee
2018-Present

14. Congress of Neurological Surgeons

Member, AANS/ CNS Brain Metastases Guidelines Taskforce
2016-2018
Member, AANS/ CNS Low Grade Glioma Guidelines Taskforce
2020-Present
Lead Writer, AANS/ CNS Low Grade Glioma Radiotherapy Guidelines
2020-Present

15. International Stereotactic Radiosurgery Society

Board Member, Non-CNS SBRT Guidelines
2021-Present

Memberships in professional societies:

American Society for Radiation Oncology, 2001- Present
Radiological Society of North America, 2001- Present
American College of Radiology, 2002- Present
American Medical Association, 1997- Present
Canadian Association of Radiation Oncology, 2013-Present
Radiosurgery Society, 2015-Present
American Radium Society, 2016-Present
American Society of Clinical Oncology, 2001-Present

Teaching Responsibilities

Visiting Professorships:

Visiting Professor, Department of Radiation Oncology
University of Michigan, Ann Arbor, MI
Lecture: "Does the extent of surgery have any impact on the survival of patients with low grade glioma who receive postoperative radiation therapy?"
November 2001

Visiting Professor, Department of Radiation Oncology
Yale University, New Haven, CT
Lecture: "Stereotactic Radiosurgery vs. Fractionated Stereotactic Radiotherapy for Meningiomas"
January 2002

Visiting Professor, Division of Radiation Oncology
Mayo Clinic, Rochester, MN
Lecture: "Does the extent of surgery have any impact on the survival of patients with low grade glioma who receive postoperative radiation therapy?"
January 2002

Visiting Professor, Department of Radiation Oncology

Loyola University Medical Center, Maywood, IL
Lecture: “Does the extent of surgery have any impact on the survival of patients with low grade glioma who receive postoperative radiation therapy?”
January 2002

Visiting Professor, Department of Radiation Oncology
Indiana University, Indianapolis, IN
Lecture: “Stereotactic Radiosurgery vs. Fractionated Stereotactic Radiotherapy for Meningiomas”
September 12, 2003

Invited Faculty for Osler Institute Radiation Oncology Board Review Course (Pediatric Oncology and Lymphoma/ Leukemia), Louisville, KY, June 2004

Invited Faculty for Osler Institute Radiation Oncology Board Review Course (Pediatric Oncology, Neuro-oncology and Lymphoma/ Leukemia), Louisville, KY, June 2005

Visiting Professor, Department of Radiation Medicine
Arthur James Cancer Hospital
Ohio State University Comprehensive Cancer Center
Lecture: “Stereotactic Radiosurgery With or Without Whole Brain Radiation Therapy for Brain Metastases”
September 26, 2005

Visiting Professor, Brain Tumor Institute
Cleveland Clinic Foundation
Lecture: “The Role of Gamma Knife Radiosurgery (GKR) in the Management of Unresectable Gross Disease or Gross Residual Disease after Surgery in Ependymoma”
October 31, 2005

Visiting Professor, Division of Radiation Oncology
H. Lee Moffitt Comprehensive Cancer Center, Tampa, FL
Lectures: “Stereotactic Radiosurgery vs. Fractionated Stereotactic Radiotherapy for Meningiomas” and “Stereotactic Body Radiation Therapy- Clinical Applications”
November 7, 2005

Visiting Professor, Department of Clinical Oncology
Queen Elizabeth Hospital, Hong Kong SAR, China
Lecture: “Stereotactic Body Radiation Therapy- Clinical Applications”
January 10, 2006

Guest Faculty, Neurosurgical Symposium
Sponsored by Asian Congress of Neurological Surgeons
Hong Kong Sanatorium, Hong Kong SAR, China
Lectures: “Stereotactic Radiosurgery vs. Fractionated Stereotactic Radiotherapy for Meningiomas” and “The Role of Gamma Knife Radiosurgery (GKR) in the Management of Unresectable Gross Disease or Gross Residual Disease after Surgery in Ependymoma”
January 12, 2006

Invited Faculty for Med Prep Radiation Oncology Board Review Course (Pediatric Oncology, Neuro-oncology and Lymphoma/ Leukemia), Louisville, KY, June 2006

Visiting Professor
National University Cancer Institute of Singapore

June 21-23, 2010
Comments: I was invited to National University Cancer Institute of Singapore to conduct a training course in stereotactic body radiotherapy (SBRT) for all organ sites and will help them set up an operational SBRT program.

Visiting Professor
UT Southwestern Medical Center
Dallas, TX
Lecture: Stereotactic Body Radiation Therapy for Spinal Metastasis
June 28, 2010

Visiting Professor
University of Minnesota, Minneapolis VA Medical Center
Minneapolis, MN
Lecture: Stereotactic Body Radiation Therapy for Early Stage Non-Small Cell Lung Cancer
July 12, 2010

Visiting Professor
UH Case Medical Center
Case Western Reserve University
Cleveland, OH
Lecture: Stereotactic Body Radiation Therapy for Spinal Metastasis
July 21, 2010

Visiting Professor
Houston Methodist Hospital, Cancer Center and Research Institute
Weill Cornell Medical College
Houston, TX
Lectures: SBRT for spinal metastasis
Toxicities associated with SBRT
Tutorials given to radiation oncology residents from The Methodist Hospital and Baylor College of Medicine
November 9, 2012

Visiting Professor
Sunnybrook Health Science Centre
Odette Cancer Centre
University of Toronto
Toronto, ON
Canada
Lecture: Toxicities associated with SBRT and strategies to mitigate the risk
Cancer Research Rounds
December 4, 2012
Comments: Odette Cancer Centre is one of the largest radiation oncology programs in the world, treating ~ 500 patients per day in one single department.

Visiting Professor
Juravinski Cancer Centre at Hamilton Health Sciences
McMaster University
Hamilton, ON
Canada
Lectures: Emerging applications of SBRT (Regional Oncology Rounds)
Toxicities associated with SBRT and strategies to mitigate the risk (Radiotherapy-Specific Rounds)
Tutorial to residents

April 25, 2013

Visiting Professor
Cardinal Bernadine Cancer Center
Loyola University Medical Center
Chicago, IL
Lecture: Emerging applications of SBRT
December 2, 2013

Fifth Annual Dr. Roger Potish Memorial Visiting Professorship and Lecture
University of Minnesota
Minneapolis, MN
USA
Lectures: SBRT for spinal metastasis
Tutorials to residents
May 9, 2014

Visiting Professor
Pamela Youde Nethersole Eastern Hospital
(One of the teaching hospitals of University of Hong Kong and the Chinese University of Hong Kong with a residency training program in Clinical Oncology)
Hong Kong SAR, China
Lectures: Emerging applications of stereotactic body radiotherapy
Toxicities associated with SBRT and strategies to mitigate the risk
Stereotactic body radiotherapy for spinal metastasis
Comments: Symposium and Training in SBRT
May 17, 2014

Visiting Professor
Tuen Mun Hospital (with a residency training program in Clinical Oncology)
Hong Kong SAR, China
Intracranial stereotactic radiosurgery
May 19, 2014

Visiting Professor
London Regional Cancer Program
University of Western Ontario
London, ON
Canada
Lecture: Toxicities associated with SBRT and strategies to mitigate the risk
Tutorials to residents
June 3, 2014

Visiting Professor
National University Cancer Institute of Singapore
Singapore
Lecture: Oligometastasis in 2015 - Fact or Myth?
May 15, 2015

Visiting Professor
University of Washington
Seattle, WA

Lecture: Emerging applications of SBRT- Additions to armamentarium against cancer
October 28, 2015

Visiting Professor
Sunnybrook Odette Cancer Centre
University of Toronto
Toronto, ON
Canada
Cancer Research Rounds: Emerging applications of SBRT
July 5, 2016

Visiting Professor
Sunnybrook Odette Cancer Centre
University of Toronto
Toronto, ON
Canada
Rapid Response Radiotherapy Program
Lecture: The medical systems in US and Hong Kong
July 5, 2016

Visiting Professor/ Guest Lecturer
Faculty of Medicine, The Chinese University of Hong Kong
Hong Kong
Guest lecture: The importance of basic sciences in radiation oncology
October 31, 2016

Visiting Professor
Division of Radiation Oncology
Department of Surgery
British Columbia Cancer Agency
University of British Columbia
Vancouver, BC
Canada
Lecture: Emerging applications of SBRT- Additions to armamentarium against cancer
May 4, 2017

Visiting Professor
Department of Radiation Oncology
Cleveland Clinic Foundation
Cleveland, OH
Lecture: Toxicities associated with SBRT and strategies to mitigate the risk
October 25, 2017

Visiting Professor
Prince of Wales Hospital/ Chinese University of Hong Kong
Hong Kong
NTEC spine metastasis special multidisciplinary meeting
Lecture: Contemporary SBRT for spine metastasis
June 29, 2018

Visiting Professor
Winship Cancer Institute / Emory University

Atlanta, GA
Cancer Center Grand Rounds:
Serious toxicities from SBRT- How to navigate through the bumpy skies safely
Meeting with the radiation oncology residents
October 8-9, 2019

Visiting Professor (Virtual amid COVID-19)
Department of Radiation Medicine
Georgetown University
Washington DC
Lecture: Strategies to mitigate serious toxicities from SBRT
Meeting with radiation oncology residents
May 18, 2020

Virtual Visiting Professor
Department of Radiation Oncology
Allegheny Healthcare Network
Lecture: The incorporaton of SBRT into multidisciplinary spine oncology care
December 16, 2020

Visiting Professor (Virtual amid COVID-19)
Department of Radiation Oncology
USC
Lecture: Toxicities of Stereotactic Body Radiotherapy- How to navigate through the bumpy skies
March 18, 2021

Visiting Professor (Virtual amid COVID-19)
Department of Radiation Oncology
Indiana University
Lecture: Serious toxicities of SBRT
June 19, 2021

Visiting Professor (Virtual amid COVID-19)
Spine Oncology Group
Indiana University
Lecture: How to build a multidisciplinary spine oncology program
June 19, 2021

Visiting Professor (Virtual amid COVID-19)
Queen's University, Kingston, ON, Canada
Lecture: How to build a multidisciplinary spine oncology program
May 19, 2022

Other invited lectures at major academic centers:

Division of Radiation Oncology
Mayo Clinic, Rochester, MN
Lecture: "Stereotactic Radiosurgery vs. Fractionated Stereotactic Radiotherapy for Meningiomas"
August 2000

Division of Radiation Oncology
Johns Hopkins Cancer Center, Baltimore, MD

Lecture: “Stereotactic Radiosurgery vs. Fractionated Stereotactic Radiotherapy for Meningiomas”
October 2000

Department of Human Oncology
University of Wisconsin, Madison, WI
Lecture: “Stereotactic Radiosurgery vs. Fractionated Stereotactic Radiotherapy for Meningiomas”
November 2000

Department of Radiation Oncology
Barbara Ann Karmanos Cancer Institute, Detroit, MI
Lecture: “Stereotactic Radiosurgery vs. Fractionated Stereotactic Radiotherapy for Meningiomas”
November 2000

Department of Radiation Oncology
University of Cincinnati, Cincinnati, OH
Lecture: “Stereotactic Radiosurgery vs. Fractionated Stereotactic Radiotherapy for Meningiomas”
November 2000

Department of Radiation Oncology
University of Florida, Gainesville, FL
Lecture: “Stereotactic Radiosurgery vs. Fractionated Stereotactic Radiotherapy for Meningiomas”
November 2000

Department of Radiation Oncology
Thomas Jefferson University Bodine Cancer Center, Philadelphia, PA
Lecture: “Stereotactic Radiosurgery vs. Fractionated Stereotactic Radiotherapy for Meningiomas”
December 2000

Department of Radiation Oncology
Medical University of South Carolina, Charleston, SC
Lecture: “Stereotactic Radiosurgery vs. Fractionated Stereotactic Radiotherapy for Meningiomas”
December 2000

Department of Radiation Oncology
University of Alabama, Birmingham, AB
Lecture: “Stereotactic Radiosurgery vs. Fractionated Stereotactic Radiotherapy for Meningiomas”
December 2000

Grand Rounds and Seminars for Community Physicians:

Stereotactic Radiosurgery for Intracranial Disease
Grand Rounds
Magruder Hospital
Port Clinton, OH
September 27, 2011

Stereotactic Radiosurgery for Intracranial Disease
Grand Rounds
Elyria Mercy Hospital
Elyria, OH
November 2,, 2011

Stereotactic Radiosurgery for Intracranial Disease
Grand Rounds
St. John Medical Center
Westlake, OH
November 11, 2011

Stereotactic Radiosurgery for Intracranial Disease
Grand Rounds
St. Vincent's Charity Hospital
Cleveland, OH
November 16, 2011

Stereotactic Radiosurgery for Intracranial Disease
Grand Rounds
Firelands Medical Center
Sandusky, OH
January 4, 2012

Stereotactic Radiosurgery for Intracranial Disease
Grand Rounds
Southwest General Hospital
Middleburg Heights, OH
January 27, 2012

Stereotactic Radiosurgery for Intracranial Disease
Grand Rounds
Robinson Memorial Hospital
Ravenna, OH
February 15, 2012

Stereotactic Radiosurgery for Intracranial Disease
Grand Rounds
UH Geauga Medical Center
Chardon, OH
May 8, 2012

Stereotactic Radiosurgery for Intracranial Disease
Grand Rounds
Summa Barberton Hospital- Parkview (Cancer) Center
Barberton, OH
August 16, 2012

Stereotactic Radiosurgery for Intracranial Disease
Grand Rounds
Memorial Hospital
Fremont, OH
September 27, 2012

Stereotactic Radiosurgery for Intracranial Disease
Grand Rounds
Christ Hospital

Cincinnati, OH
September 12, 2013

Modern Advances in Radiotherapy for Brain and Spinal Tumors
Grand Rounds
Northside Medical Center
Youngstown, OH
October 17, 2013

Stereotactic Radiosurgery and Stereotactic Body Radiotherapy
Grand Rounds
Blanchard Valley Medical Center
Findlay, OH
November 1, 2013

Grand Rounds and Seminars For Students, Residents and Fellows:

Monthly oral board preparation sessions for residents
Gershenson Radiation Oncology Center
Karmanos Cancer Institute
Wayne State University, Detroit, MI
July 2001 to June 2002

Brain Metastasis- From the Radiotherapeutic Perspective
Neurology Grand Round on 3/1/02, Morse Auditorium, Wayne State University, Detroit, MI

Nasopharyngeal Carcinoma- the American, Canadian and Hong Kong perspectives
Radiation Oncology Grand Round on 4/23/02
Gershenson Radiation Oncology Center
Wayne State University, Detroit, MI

Mock oral board examiner in central nervous system tumors for residents at University of Minnesota on 4/27/02
Department of Therapeutic Radiology-Radiation Oncology
University of Minnesota, Minneapolis, MN

Hodgkin's Disease
Radiation Oncology Grand Round on 9/27/02
Loyola University Medical Center, Maywood, IL

Parameningeal Rhabdomyosarcoma
Surgical Grand Round on 10/23/02
Loyola University Medical Center, Maywood, IL

Plasma Cell Tumors and Multiple Myeloma
Radiation Oncology Grand Round on 1/3/03
Loyola University Medical Center, Maywood, IL

Esophageal Cancer
Radiation Oncology Grand Round on 3/21/03
Loyola University Medical Center, Maywood, IL

Extranodal Lymphoma
Radiation Oncology Grand Round on 9/5/03
Loyola University Medical Center, Maywood, IL

Pediatric Sarcoma
Radiation Oncology Grand Round on 6/18/04
Loyola University Medical Center, Maywood, IL

Wilm's Tumor
Radiation Oncology Didactic Lecture on 10/20/04
Indiana University Medical Center

Rhabdomyosarcoma
Radiation Oncology Didactic Lecture on 10/27/04
Indiana University Medical Center

Retinoblastoma
Radiation Oncology Didactic Lecture on 11/3/04
Indiana University Medical Center

Hodgkin Lymphoma- Role of Radiation Therapy
Cancer Center Grand Round on 3/4/05
Indiana University Medical Center

Role of Stereotactic Radiosurgery in Brain Metastases
Radiation Oncology Didactic Lecture on 9/19/05
Indiana University Medical Center

Extranodal Lymphoma
Radiation Oncology Didactic Lecture on 12/21/05
Indiana University Medical Center

Central Nervous System Tumors
Mock Oral Boards for Residents on 3/1/06
Indiana University Medical Center

Stereotactic Radiosurgery for Pituitary Tumors
Endocrinology Grand Rounds on 3/22/06
Indiana University Medical Center

Stereotactic Radiosurgery for Intracranial and Skull Base Tumors
Lecture for Gamma Knife Radiosurgery Training Course on 5/17/06
Indiana University Medical Center

Radiation Therapy for Malignant Gliomas
Neurosurgery and Neurology Grand Round on 8/3/06
Ohio State University Medical Center

Modern Radiation Techniques And Their Applications To Brain Tumors
Neuro-oncology Symposium on 9/16/06
Ohio State University Medical Center

Extranodal Lymphoma
Didactic lecture for residents on 2/23/07
Ohio State University Medical Center

Plasma Cell Tumors
Didactic lecture for residents on 3/2/07
Ohio State University Medical Center

Extracranial Stereotactic Radiotherapy.
Lung Cancer Care for 21st Century on 3/3/07
Ohio State University Medical Center

Stereotactic Radiosurgery for Acoustic Neuroma
Neurosurgery and Neurology Grand Round on 4/5/07
Ohio State University Medical Center

Adult and pediatric brain tumors
2 lectures for radiation therapy students
October 2007

Pediatric cancer
2 lectures for radiation therapy students
November 2007

Didactic lecture series on CNS tumors including radiosurgery for residents
Weekly
Starting January 2008

Stereotactic body radiation therapy for medically inoperable non-small cell lung cancer
November 23, 2009

Imaging Solutions in Cancer Management: A Case-Based Conference
UH Seidman Cancer Center
Case Western Reserve University
September 8, 2011

Local Aggressive Therapy for Oligometastases
Cancer Center Grand Rounds
UH Seidman Cancer Center
Case Western Reserve University
October 26 ,2011

Gamma Knife Radiosurgery
Neuroscience Grand Rounds
UH Case Medical Center
Case Western Reserve University
November 4, 2011

Serious Toxicities Associated with Stereotactic Body Radiation Therapy
Radiation Oncology Grand Rounds
UH Seidman Cancer Center
Case Western Reserve University

October 16, 2012

Mock oral boards for residents (CNS tumors)
UH Seidman Cancer Center
Case Western Reserve University
May 31, 2013

Stereotactic Body Radiotherapy for Spinal Metastasis
Lecture for Residents and Students
UH Seidman Cancer Center
Case Western Reserve University
August 7, 2013

Stereotactic Body Radiotherapy for Oligometastases
Lecture for Residents and Students
UH Seidman Cancer Center
Case Western Reserve University
September 11, 2013

Emerging Applications of Stereotactic Ablative Radiotherapy
Radiation Oncology Grand Rounds
UH Seidman Cancer Center
Case Western Reserve University
December 17, 2013

Does conventional wisdom hold for SRS/ SBRT?
Lecture for Residents and Students
UH Seidman Cancer Center
Case Western Reserve University
May 7, 2014

Spinal SBRT- Practical Essentials
Radiation Oncology Resident Teaching Conference
UH Seidman Cancer Center
Case Western Reserve University
February 4, 2015

Stereotactic Radiosurgery (Part 1)
Lecture for neurosurgery residents
UH Seidman Cancer Center
Case Western Reserve University
March 4, 2015

Stereotactic Radiosurgery (Part 2)
Lecture for neurosurgery residents
UH Seidman Cancer Center
Case Western Reserve University
May 20, 2015

Strategies to guide safe and effective delivery of spine SBRT
Teaching session for radiation oncology residents
UH Seidman Cancer Center

Case Western Reserve University
February 18, 2016

Glioblastoma
Teaching session for radiation oncology residents
UH Seidman Cancer Center
Case Western Reserve University
February 25, 2016

Meningioma
Teaching session for radiation oncology residents
UH Seidman Cancer Center
Case Western Reserve University
March 3, 2016

AVM and Trigeminal Neuralgia
Teaching session for radiation oncology residents
UH Seidman Cancer Center
Case Western Reserve University
March 10, 2016

SBRT for spinal metastases
Teaching session for radiation oncology residents
University of Washington School of Medicine
September 7, 2016

Radiotherapy for uncomplicated bone metastases
Teaching session for radiation oncology residents
University of Washington School of Medicine
March 31, 2017

Stereotactic Body Radiotherapy- Additions to the Armamentarium against Spinal Metastases
University of Washington Neurosurgery Grand Rounds
University of Washington School of Medicine
July 5, 2017

Stereotactic body radiotherapy for spinal metastasis – Target delineation, challenges in response assessment and SPINO
University of Washington Radiation Oncology Grand Rounds
University of Washington School of Medicine
July 26, 2017

Brain metastasis
Teaching session for radiation oncology residents
University of Washington School of Medicine
August 8, 2018

Spinal metastasis
Teaching session for radiation oncology residents
University of Washington School of Medicine
August 24, 2018

Serious complications from SBRT- A word of caution

University of Washington Radiation Oncology Grand Rounds
University of Washington School of Medicine
September 26, 2018

Sacral SBRT CTV e-contouring and workshop for residents
UW residents teaching session
June 21, 2019

SBRT for spinal metastasis
UW residents teaching session
July 30, 2019

Primary brain glioma
UW residents teaching session
August 16, 2019

Glioma
UW residents teaching session
8/14/2020

SBRT for spinal metastasis
UW residents teaching session
8/18/2020

Econtouring for spinal metastasis
UW residents teaching session
8/21/2020

Spinal metastasis and spinal cord compression
UW residents teaching session
August 2021

Spinal metastasis and spinal cord compression
UW residents case conference
August 2021

Residents' Teaching Sessions:

Regular attendance of teaching conferences for medical students and residents at Wayne State University, Loyola University Medical Center, Indiana University Medical Center, Arthur G. James Cancer Hospital (The Ohio State University), University Hospitals Seidman Cancer Center/ Case Western Reserve University and University of Washington Medical Center.

Clinical
Contact hours-
40-50 hours per week for residents
Variable for medical students and fellows

C Michael Wilkinson, M.D.
Resident
7/01-6/02
Barbara Ann Karmanos Cancer Institute

Detroit, MI
Currently in private practice in Grand Rapids

Faheem Ahmad, M.D.
Resident
7/01-6/02
Barbara Ann Karmanos Cancer Institute
Detroit, MI
Currently faculty at Medical University of Ohio, Toledo, OH

Tanya Powell, M.D.
Resident
7/01-6/02
Barbara Ann Karmanos Cancer Institute
Detroit, MI
Currently in private practice in Chicago

Sameer Keole, M.D.
Resident
7/01-6/02
Barbara Ann Karmanos Cancer Institute
Detroit, MI
Currently faculty at Mayo Clinic, Scottsdale, AZ

David Hsu, M.D.
Resident
7/02-6/03
Loyola University Medical Center
Maywood, IL
Currently in private practice

Robert Prock, M.D.
Resident
7/02-6/04
Loyola University Medical Center
Maywood, IL
Currently in private practice in Indiana

Richard Garza, M.D.
Resident
7/02-6/04
Loyola University Medical Center
Maywood, IL
Currently faculty at Loyola University Medical Center

Paul Crossan, M.D.
Resident
7/02-6/04
Loyola University Medical Center
Maywood, IL
Currently in private practice in Indiana

Rajanish Singla, M.D.
Resident
7/02-6/04
Loyola University Medical Center
Maywood, IL
Currently in private practice

Suneel Nagda, M.D.
Resident
7/02-6/04
Loyola University Medical Center
Maywood, IL
Currently faculty at University of Pennsylvannia

Brent Tinnel, M.D.
Resident
7/04-6/06
Indiana University Medical Center
Indianapolis, IN
Currently faculty ay Madigan Army Medical Ctr, Seattle, WA

Achilles Fakiris, M.D.
Resident
7/04-6/06
Indiana University Medical Center
Indianapolis, IN
Currently faculty at University of North Carolina, Chapel Hill, NC

Ramzi Abdulrahman, M.D.
Resident
7/04-6/05
Indiana University Medical Center
Indianapolis, IN
Currently faculty at UT Southwestern Med Ctr, Dallas, TX

David Hoopes, M.D.
Resident
7/04-6/06
Indiana University Medical Center
Indianapolis, IN
Currently faculty ay Wright-Patterson Air Force Med Ctr, Dayton, OH

David Shaeffer, M.D.
Resident
7/04-6/05
Indiana University Medical Center
Indianapolis, IN
Currently in private practice

Bedatri Sinha, M.D.
Resident
7/04-6/06

Indiana University Medical Center
Indianapolis, IN
Currently in private practice

James W. Clarke, M.D.
Resident
7/06-9/06
7/07-9/07
Arthur G. James Cancer Hospital
Columbus, OH
Currently in private practice in Utah

Moataz El-Ghamry, M.D.
Resident
1/1/07-2/28/07
Arthur G. James Cancer Hospital
Columbus, OH
Currently faculty at University of Louisville, Louisville, KY

Granger Scruggs, M.D.
Resident
10/1/06-12/31/06
Arthur G. James Cancer Hospital
Columbus, OH
Currently in private practice in Dallas

Andrew Figura, M.D.
Resident
4/1/07-6/30/07
Arthur G. James Cancer Hospital
Columbus, OH
Currently in private practice in Erie, PA

Timothy Korytko, M.D.
Resident
10/1/07-12/31/07
Arthur G. James Cancer Hospital
Columbus, OH
Currently in private practice in Wisconsin

Jeffrey Radawski, M.D.
Resident
10/09-12/09
Arthur G. James Cancer Hospital
Columbus, OH
Currently in private practice in Kalamazoo, MI

Michael Guiou, M.D.
Resident
1/10-3/10
Arthur G. James Cancer Hospital
Columbus, OH

Currently faculty at The Ohio State University, Columbus, OH

Allison Quick, M.D.
Resident
4/08-6/08
Arthur G. James Cancer Hospital
Columbus, OH
Currently faculty at The Ohio State University, Columbus, OH

Mersiha Hadziahmetovic, MD
Resident
5/09-6/09
Arthur G. James Cancer Hospital
Columbus, OH
First job- Faculty at Vanderbilt University (Lead head and neck radiation oncologist)

Nicholas Galanopoulos, M.D.
Resident
4/11-6/11
UH Seidman Cancer Ctr, Case Western Reserve University
Cleveland, OH
Currently in private practice in Atlanta, GA

Charles Woods, M.D.
Resident
7/11-9/11
UH Seidman Cancer Ctr, Case Western Reserve University
Cleveland, OH
Currently in private practice in Atlanta, GA

Anton Khouri, M.D.
Resident
9/11-12/11, 9/13-10/13
Currently in private practice in Cincinnati, OH

Charlene Kan, M.D., Ph.D.
Resident
7/12-9/12
10/15-12/15
UH Seidman Cancer Ctr, Case Western Reserve University
Cleveland, OH
Currently the Chief of Radiation Oncology at Cleveland VA

Christian Okoye, M.D.
Resident
4/13-6/13
UH Seidman Cancer Ctr, Case Western Reserve University
Cleveland, OH
Currently in private practice

Ravi Patel, M.D.
Resident

7/13-8/13
7/15-9/15
UH Seidman Cancer Ctr, Case Western Reserve University
Cleveland, OH
Currently Research Fellow at University of Wisconsin

Mazen Mislmani, M.D.
Resident
3/12-4/12, 11/13-12/13
UH Seidman Cancer Ctr, Case Western Reserve University
Cleveland, OH
Currently in private practice in Kalamazoo, MI

Bryan Traughber, M.D.
Resident
1/13-3/13
1/16-Present
UH Seidman Cancer Ctr, Case Western Reserve University
Cleveland, OH
Currently on faculty at Cleveland VA

Mussadiq Awan, MD
Resident
7/14-9/14
UH Seidman Cancer Ctr, Case Western Reserve University
Cleveland, OH
Currently faculty at Medical College of Wisconsin

Thomas Mullen, MD
Resident
1/17-2/17
University of Washington Medical Center
Seattle, WA
Currently in private practice in Oregon

Matthew Spraker, MD, PhD
Resident
7/17-9/17
University of Washington Medical Center
Seattle, WA
Currently faculty at Washington University

Stephanie Schaub, MD
Resident
1/18-3/18
University of Washington Medical Center
Seattle, WA

Samuel Day, MD, PhD
Resident
7/18-9/18
University of Washington Medical Center

Seattle, WA

Aileen Kim, MD
Resident
10-12/18
University of Washington Medical Center
Seattle, WA

Amber Post, MD
Resident
July 1-August 15, 2019
University of Washington Medical Center
Seattle, WA

Matthew Greer, MD
Resident
January-March 2020
University of Washington Medical Center
Seattle, WA

Khang Dinh, MD
Resident
2020
University of Washington Medical Center
Seattle, WA

Bory Eastman, MD
Resident
April 2021
University of Washington Medical Center
Seattle, WA

August Anderson, MD
Resident
July-August 2021
University of Washington Medical Center
Seattle, WA

Sasha Swensen, MD
Resident
September-October 2021
University of Washington Medical Center
Seattle, WA

Macklin Nguyen, MD
Resident
December 2021-February 2022
University of Washington Medical Center
Seattle, WA

Peter Goff, MD
Resident

April 2021
University of Washington Medical Center
Seattle, WA

Clinical Fellows:

UH Seidman Cancer Center, Case Western Reserve University

Anton Khouri, MD
SRS/ SBRT Fellow
11/14-6/15
UH Seidman Cancer Center, Case Western Reserve University
Cleveland, OH

Tai-Chung Lam, MB, BS, FRCR
Visiting Fellow
3/31/2014-4/4/2014
Dana-Farber Cancer Institute/ Brigham & Women Hospital
Harvard Medical School
Boston, MA

Kin-Chung Lee, MB, ChB, FRCR
Visiting Fellow
9/18/2014-9/30/2014
Pamela Youde Nethersole Eastern Hospital
Hong Kong

Jacky Li, MB, BS, FRCR
Visiting Fellow
3/1/2015-3/31/2015
Queen Elizabeth Hospital
Hong Kong

University of Washington

Dennis Leung, MB, BS, FRCR
Visiting fellow
1/17-2/17
University of Hong Kong

Ka-Man Cheung, MB, ChB, FRCR
Visiting fellow
5/17-6/17
Queen Elizabeth Hospital, Hong Kong

Leslie Fok, MB, ChB, FRCR
Visiting fellow
9/18
Queen Elizabeth Hospital
Hong Kong

Luke Lee, MB, BS, FRCR

Visiting fellow
10/18
Queen Elizabeth Hospital
Hong Kong

Jane Cho, MD
SBRT Fellow
University of Washington Medical Center
Seattle, WA

Medical Student Mentorship:

Wayne State University

Daniel Chang
Wayne State University Medical Student
One month in 2002
Currently Professor at Stanford University

Loyola University

Michelle Mierzwa
University of Cincinnati Medical Student
One month in 2002
Currently on faculty at University of Michigan

Amit Bhatt
Southern Illinois University
One month in 2003
Graduated from Northwestern University Radiation Oncology Program

Angela Babbo
Rush University
One month in 2003
Graduated from Northwestern University Radiation Oncology Program

Ohio State University

Katherine Tsao
OSU Medical Student, Class 2007
One month in 2006
Currently attending at Mayo Clinic, Jacksonville

Mersiha Hadziahmetovic
OSU Medical Student, Class 2007
One month in 2006
Resident
5/09-3/11
Arthur G. James Cancer Hospital
Columbus, OH
Currently faculty at Case Western Reserve University

Eugene Hong
OSU Medical Student, Class 2008
Columbus, OH
Currently in private practice

Steven Register
OSU Medical Student, Class 2008
One month in 2007
Currently in private practice

David Chang
University of Louisville Medical Student, Class 2008
One month in 2007
Currently in private practice

Michael Crotty
Medical University of Ohio Medical Student, Class 2008
One month in 2007
Currently in private practice

William A. Hall
Loyola University School of Medicine Medical Student, Class 2009
Currently faculty at Medical College of Wisconsin

Michael K. Cheung
Medical University of Ohio Medical Student, Class 2010
Currently faculty at Los Angeles VA

Case Western Reserve University

Kevin Shuie
Medical student
Case Western Reserve University
Current radiation oncology resident at Indiana University

Brent Cameron, Ph.D.
Medical student
Case Western Reserve University
Current radiation oncology resident at Vanderbilt University

Lindsay Hwang
Medical student
Case Western Reserve University
Current radiation oncology resident at University of Southern California

Shaakir Hasaan
Medical student
Nova School of Osteopathic Medicine
Current radiation oncology resident at Allegheny General Hospital

Sarah Zakem
Medical student

Case Western Reserve University
Current radiation oncology resident at University of Colorado

Nicholas Damico
Medical student
Case Western Reserve University
Current radiation oncology resident at University Hospitals Seidman Cancer Center

Scott Chen
Medical student
Case Western Reserve University
Current radiation oncology resident at Johns Hopkins University

Prachi Jain, M.D.
9/11
Internal Medicine Resident
UH Case Medical Center
Case Western Reserve University
Currently resident at Hofstra School of Medicine, Long Island, New York

Andrew Song
Medical student
Case Western Reserve University
Current radiation oncology resident at Thomas Jefferson University

University of Washington

Samuel Kosydar
University of Washington
MS3

Research Mentorship:

RT vs. chemoRT for cervical cancer with periaortic nodal metastasis
Ayman Saad, M.D., Barbara Ann Karmanos Cancer Institute
Outcome: One full manuscripts published

Prostascint for postoperative prostate cancer patient receiving external beam radiotherapy
Suneel Nagda, M.D., Loyola University Medical Center
Outcome: One full manuscripts published

Invasion of inferior vena cava by neuroblastoma
Suneel Nagda, M.D., Loyola University Medical Center
Outcome: One full manuscripts published

Stereotactic radiosurgery for secretory pituitary adenoma
Brent Tinnel, M.D., Indiana University
Outcome: One full manuscripts published

Stereotactic radiosurgery for ependymoma
Ramzi Abdulrahman, M.D., Indiana University
Outcome: One full manuscripts published

Stereotactic radiosurgery for uveal melanoma
Achilles Fakiris, M.D., Indiana University
Outcome: One full manuscripts published

Stereotactic radiosurgery for macular degeneration
Mark Henderson, M.D., Indiana University
Outcome: One full manuscripts published

Stereotactic radiosurgery for low grade glioma
Mark Henderson, M.D., Indiana University
Outcome: One full manuscripts published

P-32 for craniopharyngioma
R Bryan Barriger, M.D., Indiana University
Outcome: One full manuscripts published

PET and SBRT for non-small cell lung cancer
David Hoopes, M.D., Indiana University
Outcome: One full manuscripts published

Pathologic complete response of melanoma brain metastasis after SRS
Steven Register, M.D. (OSU medical student)
Outcome: One full manuscripts published

Stereotactic radiosurgery for radioresistant brain metastases
James Clarke, M.D., Ohio State University
Outcome: 3 full manuscripts published

Stereotactic radiosurgery for breast cancer brain metastasis
Jeffrey Radawski, M.D., Ohio State University
Outcome: One full manuscript published

Stereotactic body radiotherapy for adrenal metastasis
Michael Guiou, M.D., Ohio State University
Outcome: One full manuscript published

Application for Radiological Society of America Medical Student Grant
Title: Gamma Knife Radiosurgery For Breast Cancer Brain Metastasis- Impact of HER-2 Status
February 2012
Andrew Song, 1st year medical student
Case Western Reserve University School of Medicine
Outcome: Not funded

Ray Tracing vs. Monte Carlo algorithm for SBRT for thoracic spinal metastasis
Mentee: Christian Okoye, M.D. (Resident at Case Western Reserve University)
Outcome: ASTRO presentation in 2013 and manuscript has been published in a PUBMED indexed journal

CTSC Pilot Grant (Application in progress)
RFA and SBRT for liver metastasis
Mentee: Ravi Patel, M.D., Ph.D. (Resident at Case Western Reserve University)

Consensus guidelines for stereotactic body radiotherapy for renal cell carcinoma
Presented in ASTRO 2015 and published in Future Oncology
Mentee: Shankar Siva, MB, BS, FRANZCR, Physician-Scientist, Peter MacCallum Cancer Centre, University of Melbourne, Australia

Consensus guidelines for stereotactic body radiotherapy for head and neck cancer
Two abstracts accepted for poster presentation in ASTRO 2016 and published in Future Oncology
Mentee: Irene Karam, M.D., FRCPC, Assistant Professor of Radiation Oncology, Sunnybrook Health Science Centre, University of Toronto, Canada

Consensus guidelines for stereotactic body radiotherapy for gynecologic cancer
Mentee: Eric Leung, M.D., FRCPC, Assistant Professor of Radiation Oncology, Sunnybrook Health Science Centre, University of Toronto, Canada

Consensus guidelines for CTV delineation for stereotactic body radiotherapy for sacral metastasis
Mentee: Emma Dunne, MB, BS, FRCR, British Columbia Cancer Agency

Meta-analysis of SRS and HSRT for uveal melanoma
Mentee: Samuel Kosydar (MD candidate 2021, UWSOM)
Independent Investigative Inquiry, UWSOM

Undergraduate Mentorship

Jacob Gardner
Duke University graduate
2015-Current
Comments: I have provided guidance and facilitated his plan to go to Cambodia to help build the nation's first ever cancer center. With the support from a grant, he has worked in Cambodia for over a year.

Other Mentorship

I have mentored Dr. Mark Henderson (Indiana University resident) in the preparation of a review paper in SRS and SRT for uveal melanoma.

I have mentored Dr. James Clarke (OSU resident) in the preparation of two book chapters and 2 review papers in CNS tumors.

I have mentored Dr. Allison Quick (OSU resident) in the preparation of one book chapter in meningioma in the new radiation oncology textbook "Decision Making in Radiation Oncology (Springer)" and one review paper on radiotherapy for liver tumors.

I have mentored Dr. Mersiha Hadziahmetovic (OSU resident) in the preparation of 3 review papers on medulloblastoma, CNS germ cell tumors and SBRT for lung cancer, respectively.

I have mentored Andrew Song and Kevin Shiue, both CWRU medical students on the writing of a review article, resulting in a two peer-reviewed papers:
Andrew Song, A.B. , Kevin Shiue, B.Sc. , Mitchell Machtay, M.D., Min Yao, M.D., Ph.D., Rodney J. Ellis, M.D., Zhibin Huang, Ph.D., Nina A. Mayr, M.D., Bin S. Teh, M.D., Simon S. Lo, M.D. Stereotactic body radiation therapy for metastasis in the lung: An undervalued treatment option with future prospects. Lung Cancer Management. Accepted for publication in the June 2012 issue.

Kevin Shiue, B.S., Andrew Song, A.B., Bin S. Teh, M.D., Rodney J. Ellis, M.D., Min Yao, M.D., Ph.D., Nina A. Mayr, M.D., Zhibin Huang, Ph.D., Jason Sohn, Ph.D., Mitchell Machtay, M.D., Simon S. Lo, M.D. Stereotactic body radiation therapy (SBRT) for metastasis to the adrenal gland. Expert Rev Anticancer Ther. In press.* (Impact factor ~ 2.7)

I mentored Dr. Christian Okoye, M.D., a UHSCC/ CWRU resident in the preparation of a book chapter on pediatric stereotactic radiosurgery (SRS) in a comprehensive textbook "Intracranial SRS".

Recent CME:

Weekly neuro-oncology tumor board at UH
March 2011-Present (with CME credits)

Monthly Departmental Grand Rounds at UH
2012-Present (with CME credits)

Annual Meeting of American Society for Radiation Oncology (ASTRO)
2007-2019 (with CME credits)

Annual Meeting of Radiological Society of North America (RSNA)
2009-2018 (with CME credits)

Radiosurgery Society Meeting
2014, 2019 (with CME credits)

Annual Meeting of American College of Radiology
2015, 2019 (with CME credits)

Annual Continued Risk Management Education at UH
4 hours per year
2011-2016

Editorial Responsibilities

Editorships

Editor, Discovery Medicine (Partnership with Johns Hopkins School of Medicine for CME)

Associate Editor-in-chief, Journal of Radiation Oncology, 2016-Present

Associate Senior Editor, Advances in Radiation Oncology, 2017-Present

Associate Editor, Neurosurgery, 2017-Present

Associate Editor-in-Chief, Annals of Palliative Medicine

Editor, Cancers

Editor, Frontiers in Oncology

Editorial boards

Member of Editorial Board, Clinical Medicine: Case Reports

Member of Editorial Board, Rare Tumors (Italy)

Member of Editorial Board, Expert Review of Anticancer Therapy (UK)

Member of Editorial Board, Journal of Radiation Oncology (USA)

Member of Editorial Board, Cancers (Switzerland)

Member of Editorial Board, CNS Oncology (UK)

Member of Editorial Board, Cureus (USA)

Member of Editorial Board, Future Oncology (UK)

Member of Editorial Board, Annals of Palliative Medicine

Expert Ambassador, Oncology Central (UK)

Honorary Advisor, Hong Kong Journal of Radiology (Official journal of Hong Kong College of Radiologists)

Member of Editorial Board, Journal of Radiosurgery and SBRT (USA)

Member of Editorial Board, Cancers (Switzerland)

Special National Responsibilities:

National examination board:

American Board of Radiology (Radiation Oncology)-
Contributor of questions in pediatric CNS for the written part of the American Board of Radiology examination (2009-2011)
Reviewer of SAM questions for recertification for the American Board of Radiology, starting 2009
Committee member of CNS/ pediatric section, American Board of Radiology, February 2015-Present (Responsible for creating written examination items for initial certification and maintenance of certification and oral board examination)
Oral board examiner, CNS/ pediatric, 2016, 2018, 2019 and 2021
Examination creation panel for CNS/ pediatric, January 2018-Present

External grant reviewer:

Regular external grant reviewer, Associazione Italiana per la Ricerca sul Cancro (A.I.R.C.) (Italian Association for Cancer Research)- It is one of the largest funding bodies for cancer research and is providing 50% of research money in cancer in Italy
February 2012-Present
Website: www.airc.it

External grant reviewer, Juravinski Cancer Centre Foundation, McMaster University, Hamilton, Ontario, Canada
May 2014

External grant reviewer, Cancer Research UK, United Kingdom
August/ September 2014

Regular external grant reviewer, The Food and Health Bureau (FHB) of The Government of the HKSAR
May 2015-Present

External grant reviewer, Cancer Research UK, United Kingdom
July/ August 2018

External grant reviewer, Natural Sciences and Engineering Research Council of Canada (NSERC)
November/ December 2018

Reviewer, NRG Oncology NCORP Pilot Grants
May 2019

External grant reviewer
'Highly Specialised Care & Research' programme
The Netherlands Organisation for Health, Research and Development (ZonMw)
December 2019

External grant reviewer
Palliantie Meer dan zorg
The Netherlands Organisation for Health, Research and Development (ZonMw)
March 2021

Special Local Responsibilities

University of Minnesota Radiation Oncology Residency Program:
Resident Representative (July 1998- June 1999)
Chief Resident (July 1999- June 2000))
Chief Resident (October- December 2000 and April- June 2001)
Committee Member of the Education Committee (July 1998- June 2001)
Committee Member of the Resident Selection Committee (July 1998- June 2001)

Barbara Ann Karmanos Cancer Institute/ Wayne State University:
Member, Protocol Review Committee (July 2001-June 2002)

The Ohio State University
Department of Radiation Medicine
Residency Program Director
July 1, 2006-September 2009

Arthur G. James Cancer Hospital
Director of SRS and SBRT
June 2006-February 2011

Ohio State University Cancer Institutional Review Board
Committee Member
January 2007-February 2011

The Ohio State University Health System
Physician Executive Council

July 1, 2008-February 2011

University Hospitals Case Medical Center
Radiation Safety Committee
July 2011-Present

Case Comprehensive Cancer Center
Data Safety and Toxicity Committee
January 2012-September 2013

University Hospitals Seidman Cancer Center
Radiation Oncology Residency
Clinical competency committee
September 2013-Present

University Hospitals Seidman Cancer Center
Director of Neurologic Radiation Oncology and Radiosurgery Services
January 2012- July 2016

University of Washington School of Medicine
Department of Radiation Oncology
Co-Chair, Appointment and Promotion Committee
2017-Present

UW Medicine
Department of Radiation Oncology
Member, Credentialing Committee
2016-Present

University of Washington School of Medicine
Department of Radiation Oncology
Co-Chair, Proton Faculty Search Committee
2018-Present

University of Washington School of Medicine
Department of Radiation Oncology
Co-Chair, Gynecologic Radiation Oncology Faculty Search Committee
2018-Present

University of Washington School of Medicine
Department of Radiation Oncology
Director of Stereotactic Body Radiotherapy
February 2018-Present

Key Personnel
Fred Hutchinson Cancer Research Center
Hutchinson Center as Lead Academic Participating Site (UG1 grant)
March 1, 2019-February 29, 2020

Member of Leadership Team
Fred Hutchinson Cancer Research Center
Hutchinson Center as Lead Academic Participating Site (UG1 grant)

March 1, 2020-Present

Research Protocols

Case Western Reserve University (March 1, 2011-July 22, 2016)

1. SHSC 1312- STEREOTACTIC RADIOSURGERY (SRS) +/- WHOLE-BRAIN RADIOTHERAPY (WBRT) FOR THE TREATMENT OF BRAIN METASTASES: PATIENT PREFERENCE STUDY
   Institutional PI: Simon S. Lo, M.D.
   Study PI : Edward Chow, MB,BS, FRCPC, Sunnybrook Health Science Centre, University of Toronto
   Funding: Internal

2. N107C- A Phase III Trial of Post-Surgical Stereotactic Radiosurgery (SRS) Compared with Whole Brain Radiotherapy (WBRT) for Resected Metastatic Brain Disease
   Institutional PI: Simon S. Lo, M.D.
   Study PI: Paul D. Brown, M.D., M.D. Anderson Cancer Center
   Funding: NRG Oncology
   Number of patients accrued: 2 (6 screened)

3. RTOG 0933- A PHASE II TRIAL OF HIPPOCAMPAL AVOIDANCE DURING WHOLE BRAIN RADIOTHERAPY FOR BRAIN METASTASES
   Institutional PI: Simon S. Lo, M.D.
   Study PI : Vinai Gondi, M.D., Chicago
   Funding: Radiation Therapy Oncology Group (RTOG)
   Number of patients accrued: 4

4. RTOG 1205- Randomized Phase II Trial of Concurrent Bevacizumab and Re-Irradiation Versus Bevacizumab Alone as Treatment for Recurrent Glioblastoma
   Institutional PI: Simon S. Lo, M.D.
   Study PI: Christina Tsien, M.D., FRCPC
   Funding: Radiation Therapy Oncology Group (RTOG)
   Number of patients accrued: 0

5. RTOG 1119- Phase II Randomized Study of Whole Brain Radiotherapy in Combination With Concurrent Lapatinib in Patients With Brain Metastasis From HER2-Positive Breast Cancer: A Collaborative Study of RTOG and KROG
   Study PI: In Ah Kim, M.D., Seoul National University
   Funding: Radiation Therapy Oncology Group (RTOG)
   Number of patients accrued: 0

6. CHRV0081- Database of Patients Undergoing Stereotactic Body Radiation Therapy
   Study PI: Simon S. Lo, M.D.
   Outcomes: One manuscript published and two submitted

7. Case 8810- A Phase 1 Study of Carboplatin and Gemcitabine Chemotherapy and Stereotactic Body Radiosurgery for the Palliative Treatment of Persistent or Recurrent Gynecologic Cancer
   Co-investigator: Simon S. Lo, M.D.
   Study PI: Rodney J. Ellis, M.D.
   Funding: Internal

8. RTOG 0436- Paclitaxel, Cisplatin, and Radiation Therapy With or Without Cetuximab in Treating Patients With Locally Advanced Esophageal Cancer

Institutional Co-investigator: Simon S. Lo, M.D.
Study PI: Mohan Suntharalingam, M.D., University of Maryland
Funding: RTOG

9. RTOG 0539- Phase II Trial of Observation for Low-Risk Meningiomas and of Radiotherapy for Intermediate- and High-Risk Meningiomas
Institutional Co-investigator: Simon S. Lo, M.D.
Study PI: Leland Rogers, M.D., Gamma West, Utah
Funding: RTOG

10. RTOG 0913- Phase I/II Trial of Concurrent RAD001 (Everolimus) With Temozolomide/Radiation Followed by Adjuvant RAD001/Temozolomide in Newly Diagnosed Glioblastoma
Institutional Co-investigator: Simon S. Lo, M.D.
Study PI: Leland Rogers, M.D., Gamma West, Utah
Funding: RTOG

11. RTOG 0938- A Randomized Phase II Trial Of Hypofractionated Radiotherapy For Favorable Risk Prostate Cancer-RTOG CCOP Study
Institutional Co-investigator: Simon S. Lo, M.D.
Study PI: Himu Lukka, M.D., McMaster University, Hamilton, Canada
Funding: RTOG

12. RTOG 1012- Phase II Randomized Trial of Prophylactic Manuka Honey for the Reduction of Chemoradiation Therapy Induced Esophagitis-Related Pain During the Treatment of Lung Cancer - RTOG CCOP Study
Institutional Co-investigator: Simon S. Lo, M.D.
Study PI: Lawrence Berk, M.D., Tampa General Hospital
Funding: RTOG

13. ACRIN6684- Multicenter, Phase II Assessment of Tumor Hypoxia in Glioblastoma Using 18F-Fluoromisonidazole (FMISO) With PET and MRI
Institutional Co-investigator: Simon S. Lo, M.D.
Study PI: Elizabeth R. Gerstner, M.D.
Funding: ACRIN

14. RTOG 0538- CALGB 30610/Endorsed Study: Phase III Comparison of Thoracic Radiotherapy Regimens in Patients with Limited Small Cell Lung Cancer Also Receiving Cisplatin and Etoposide
Institutional Co-investigator: Simon S. Lo, M.D.
Study PI: Jeffrey Bogart, M.D., SUNY Syracuse
Funding: RTOG

15. RTOG 0631-Phase II/III Study of Image-Guided Radiosurgery/SBRT for Localized Spine Metastasis---RTOG CCOP Study
Institutional Co-investigator: Simon S. Lo, M.D.
Study PI: Samuel Ryu, M.D., Henry Ford Hospital, Detroit
Funding: RTOG

16. RTOG 0834- Phase III Trial on Concurrent and Adjuvant Temozolomide Chemotherapy in Non-1p/19q Deleted Anaplastic Glioma: The CATNON Intergroup Trial

Institutional Co-investigator: Simon S. Lo, M.D.
N. American PI: Michael A. Vogelbaum, MD, PhD
Funding: RTOG

17. RTOG 0924- Androgen Deprivation Therapy and High Dose Radiotherapy With or Without Whole-Pelvic Radiotherapy in Unfavorable Intermediate or Favorable High Risk Prostate Cancer: A Phase III Randomized Trial
Institutional Co-investigator: Simon S. Lo, M.D.
Study PI: Mack Roach III, M.D., UCSF
Funding: RTOG

18. RTOG 0937- Randomized Phase II Study Comparing Prophylactic Cranial Irradiation Alone To Prophylactic Cranial Irradiation And Consolidative Extra-Cranial Irradiation For Extensive Disease Small Cell Lung Cancer (ED-SCLC)
Institutional Co-investigator: Simon S. Lo, M.D.
Study PI: Elizabeth Gore, M.D., Medical College of Wisconsin
Funding: RTOG

19. RTOG 1010- A Phase III Trial Evaluating the Addition of Trastuzumab to Trimodality Treatment of Her2-Overexpressing Esophageal Adenocarcinoma
Institutional Co-investigator: Simon S. Lo, M.D.
Study PI: Howard Safran, M.D.
Funding: RTOG

20. RTOG 1114- Phase II Randomized Study of Rituximab, Methotrexate, Procarbazine, Vincristine, and Cytarabine With and Without Low-Dose Whole-Brain Radiotherapy for Primary Central Nervous System Lymphoma
Institutional Co-investigator: Simon S. Lo, M.D.
Study PI: Antonio Omuro, M.D.
Funding: RTOG

21. E3F05- Radiation Therapy With or Without Temozolomide in Treating Patients With Low-Grade Glioma
Institutional Co-investigator: Simon S. Lo, M.D.
Study PI: David Schiff, M.D., University of Virginia
Funding: ECOG

22. E6508- BLP25 Liposome Vaccine and Bevacizumab After Chemotherapy and Radiation Therapy in Treating Patients With Newly Diagnosed Stage IIIA or Stage IIIB Non-Small Cell Lung Cancer That Cannot Be Removed by Surgery
Institutional Co-investigator: Simon S. Lo, M.D.
Study PI: Jyoti Patel, M.D., Northwestern Memorial Hospital
Funding: ECOG

23. Case6307- O6-Benzylguanine and Temozolomide in Combination With Genetically Modified Peripheral Blood Stem Cells in Newly Diagnosed Glioblastoma Multiforme
Co-investigator: Simon S. Lo, M.D
Study Sponsor: Stanton Gerson, M.D.
Study PI: Andrew E. Sloan, M.D.

23. NBIO1307- A Phase III Clinical Trial Evaluating DCVax-L, Autologous Dendritic Cells Pulsed with Tumor Lysate Antigen for the Treatment of

Glioblastoma Multiforme
Co-investigator: Simon S. Lo, M.D.
Institutional PIs: Andrew E. Sloan, M.D. (Case Western Reserve University) and David Peereboom, M.D. (CCF)

24. CLDX 1311- An International, Randomized, Double-Blind, Controlled Study of Rindopepimut/GM-CSF with Adjuvant Temozolomide in Patients with Newly Diagnosed, Surgically Resected, EGFRvIII-positive Glioblastoma (The "ACT IV" Study)
Co-investigator: Simon S. Lo, M.D.
Institutional PIs: Andrew E. Sloan, M.D. (Case Western Reserve University) and Gene Barnett, M.D. (CCF)

25. CLDX 2311- A Phase II Study of Rindopepimut/GM-CSF in Patients with Relapsed EGFRvIII-Positive Glioblastoma (The "ReACT" Study)
Co-investigator: Simon S. Lo, M.D.
Institutional PIs: Andrew E. Sloan, M.D. (Case Western Reserve University) and David Peereboom, M.D. (CCF)

26. CHRV 0115- Tumor Volume as a Predictor of Overall Survival for Patients with Brain Metastases Treated with Stereotactic Radiosurgery
Co-investigator: Simon S. Lo, M.D.
Study PI: Mitchell Machtay, M.D.

27. Case7Z11- Establishment of a Cancer Image Segmentation Database for Training Resident Physicians and Testing Proficiency Prior to Submitting Clinical Cases to Cooperative Groups
Co-investigator: Simon S. Lo, M.D.
Study PI: Jason Sohn, Ph.D.

28. Case 1307- Ohio Brain Tumor Study
Co-investigator: Simon S. Lo, M.D.
Study PI: Jill Barnholtz-Sloan (CWRU) and Gene Barnett (CCF)

29. BTTC 1312- Randomized, Double-Blind, Placebo-Controlled Trial of Lacosamide for Seizure Prophylaxis in Patients with High-Grade Gliomas
Co-investigator: Simon S. Lo, M.D.
Institutional PIs: PI: Lisa Rogers, D.O. (CWRU) and Manmeet Ahluwalia, M.D. (CCF)

30. ABBT 1512- A Randomized, Double-Blind, Phase 2, Dose-Ranging Study to Evaluate the Safety and Efficacy of Veliparib and Whole Brain Radiation Therapy Versus Placebo and Whole Brain Radiation Therapy in Subjects with Brain Metastases from Non-Small Cell Lung Cancer
Co-investigator: Simon S. Lo, M.D.
Institutional PIs: PI: Mitchell Machtay, M.D. (CWRU) and John Suh, M.D. (CCF)

31. A071101- Phase II Randomized Trial Comparing the Efficacy of Heat Shock Protein-Peptide Complex-96 (HSPPC-96) (NSC#725085, Alliance IND #15380) Vaccine Given with Bevacizumab Versus Bevacizumab Alone in the Treatment of Surgically Resectable Recurrent Glioblastoma Multiforme (GBM)
Co-investigator: Simon S. Lo, M.D.

Institutional PIs: Andrew E. Sloan, M.D.

32. NABTT0703- Iniparib and Temozolomide With or Without Radiation Therapy in Treating Patients With Newly Diagnosed Malignant Glioma
    Co-investigator: Simon S. Lo, M.D.
    Institutional PIs: Andrew E. Sloan, M.D

University of Washington Medical Center/ Fred Hutchinson Cancer Research Center

33. NRG BN001- Randomized Phase II Trial of Hypofractionated Dose-Escalated Photon IMRT or Proton Beam Therapy Versus Conventional Photon Irradiation With Concomitant and Adjuvant Temozolomide in Patients With Newly Diagnosed Glioblastoma
    Co-investigator at UW/ Fred Hutch: Simon S Lo, MD

34. NRG BN005- A Phase II Randomized Trial of Proton Vs. Photon Therapy (IMRT) for Cognitive Preservation in Patients With IDH Mutant, Low to Intermediate Grade Gliomas
    Co-investigator at UW/ Fred/ Hutch: Simon S. Lo, MD

35. Alliance N0577 (CODEL)- Phase III Intergroup Study of Radiotherapy With Concomitant and Adjuvant Temozolomide Versus Radiotherapy With Adjuvant PCV Chemotherapy in Patients With 1p/19q Co-deleted Anaplastic Glioma or Low Grade Glioma
    Co-investigator at UW/ Fred Hutch: Simon S Lo, MD

36. RTOG 3508/AbbVie M13-813- A Randomized, Placebo Controlled Phase 3 Study of ABT-414 with ConcurrentChemoradiation and Adjuvant Temozolomide in Subjects with Newly Diagnosed Glioblastoma (GBM) with Epidermal Growth Factor Receptor (*EGFR*) Amplification (Intellance1)
    Co-investigator at UW/ Fred Hutch: Simon S. Lo, MD

37. NRG BN003- Phase III Trial of Observation Versus Irradiation for a Gross Totally Resected Grade II Meningioma
    Co-investigator at UW/ Fred Hutch: Simon S. Lo, MD

38. ALLIANCE A211401: REDUCING SURGICAL COMPLICATIONS IN NEWLY DIAGNOSED LUNG CANCER PATIENTS WHO SMOKE CIGARETTES (PI: Ivana Croghan, PhD)
    Study champion (NRG): Simon S. Lo, MD

Others

39. TROG 15.03 FASTRACK II clinical trial-Stereotactic Ablative Radiotherapy (SABR) as a New Precision Treatment Option in Kidney Cancer
    Associate Investigator: Simon S Lo, MD
    PI: Shankar Siva, MB,BS, PhD, FRANZCR

Research Funding/ Grants

1. NIH R01

1R01CA196687
Title: Accurate MR-based PET Attenuation Correction for Quantitative Clinical Trials
$1.9M direct, $2.9M total
Sep. 2015 – Aug. 2019
PI: Raymond Muzic, Ph.D. (raymond.muzic@case.edu)
Co-investigator (5% effort without salary support)
Case Western Reserve University
Funds stayed with Case Western Reserve University when I left the institution in July 2016

2 SHSC 1312- STEREOTACTIC RADIOSURGERY (SRS) +/- WHOLE-BRAIN RADIOTHERAPY (WBRT) FOR THE TREATMENT OF BRAIN METASTASES: PATIENT PREFERENCE STUDY
Institutional PI: Simon S. Lo, M.D.
Study PI : Edward Chow, MB,BS, FRCPC, Sunnybrook Health Science Centre, University of Toronto
Funding: Internal
Amount: $3,000
Comments: Study has been completed and published.

3. Elekta International Oligometastasis Consortium (CORE group)
Institutional PI at UH/ Case Western Reserve University
Amount: Canadian $4,000 (Funds stayed with Case Western Reserve University when I left in July 2016)

4. North American Gamma Knife Consortium Registry
Institutional PI at UH/ Case Western Reserve University

5. Elekta ICON Gamma Knife Expert Group
Institutional-investigator at University of Washington/ HMC
Amount: TBD

6. UG1 CA 233328 (Yu) 03/01/19-02/28/25 0.12 CM
NIH/NCI $19,830,301
Hutchinson Center as Lead Academic Participating Site (UG1)
The goal of the NCI National Clinical Trials Network (NCTN) is to develop and conduct state-of-the-art cancer treatment and advanced imaging clinical trials, especially large, definitive multi-institutional trials evaluating new cancer therapies and related clinical approaches. NCTN Lead Academic Participating Sites (LAPS) are one component of this network and will provide scientific leadership in the development and conduct of NCTN clinical trials in association with one or more adult Network Groups as well as substantial accrual to clinical trials conducted across the entire NTCN.
Role: LAPS Leadership

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Manuscripts in refereed journals: Total 242

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2. Lo SS, Cho KH, Hall WA, Hernandez WL, Kossow RJ, Lee CK, Clark HB. Does the extent of surgery have an impact on survival for patients with supratentorial low grade gliomas who receive postoperative radiation therapy? International Journal of Cancer 2001;96(S1):71-78*. (ISI 2012 Impact factor: 6.2)

3. Lo SS, Cho KH, Hall WA , Kossow RJ, Hernandez WL, McCollow KK, Gerbi BJ, Higgins PD, Lee CK. Single dose vs. fractionated stereotactic radiotherapy for meningiomas. Can. J. Neurol. Sci. 2002; 29: 240-248*. (ISI 2012 Impact factor: 1.33)

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6. Chang E, Lo S. Diagnosis and management of Central Nervous System Metastases from Breast Cancer. Oncologist. 2003;8(5):398-410. (ISI 2012 Impact factor: 6.7)

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2. ACR Appropriateness Criteria Expert Panels on Neurological Imaging, Interventional Radiology, and Musculoskeletal Imaging: Majid A. Khan, MBBS, BS[2]; Jack W. Jennings, MD, PhD, MPH[b]; Jonathan C. Baker, MD[c]; Amanda R. Smolock, MD[d]; Lubdha M. Shah, MD[e]; Jason W. Pinchot, MD[f]; Daniel E. Wessell, MD, PhD[g]; Charles Y. Kim, MD[h]; Leon Lenchik, MD[i]; Matthew S. Parsons, MD[j]; Gina Huhnke, MD[k]; Simon Shek-Man Lo, MB, ChB[l]; Yi Lu, MD, PhD[m]; Christopher Potter , MD[n]; Charles Reitman, MD[o]; Scott S. Russo, MD[p]; Arjun Sahgal, MD[q]; Akash Sharma, MD, MBA[r]; Naga M. Yalla, MD[s]; Francesca D. Beaman, MD[t]; Baljendra S. Kapoor, MD[u]; Judah Burns, MD.[v] Management of Vertebral Compression Fractures. Will be submitted to JACR.

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6. International survey of SBRT for head and neck cancer. In progress.

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Guest Editorships:

Focused issue "Advances in Stereotactic Radio Surgery". Chinese Clinical Oncology. Vol 6, Supplement 2 (September 2017)- Guest Editors: Kevin Chua, David Tan, Melvin Chua, Simon Lo (Indexed in PUBMED)

1. Kevin L.M. Chua, David B.H. Tan, Melvin. L.K. Chua, Simon S. Lo. The promise of stereotactic body radiotherapy—next phase of integration into oncological practice.
2. Hannah Tharmalingam, Peter J. Hoskin. The optimism surrounding stereotactic body radiation therapy and immunomodulation.
3. Connie Yip, Gary J. R. Cook, Kasia Owczarczyk, Vicky Goh. Challenges in imaging assessment following liver stereotactic body radiotherapy: pitfalls to avoid in clinical practice.
4. Lijun Ma, Lei Wang, Chia-Lin Tseng, Arjun Sahgal. Emerging technologies in stereotactic body radiotherapy
5. Stewart Gaede, Michael I. Lock. Advances in external beam stereotactic body radiotherapy: principle concerns in implementing a liver radiation program.
6. Philip Gilbo, Isabella Zhang, Jonathan Knisely. Stereotactic radiosurgery of the brain: a review of common indications.
7. Morten Høyer. Re-irradiation with stereotactic body radiation therapy (SBRT).
8. Thomas A. C. Kennedy, Mark T. Corkum, Alexander V. Louie. Stereotactic radiotherapy in oligometastatic cancer.
9. Gargi Kothari, Alexander V. Louie, David Pryor, Ian Vela, Simon S. Lo, Bin S. Teh, Shankar Siva. Stereotactic body radiotherapy for primary renal cell carcinoma and adrenal metastases.
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12. Kevin L. M. Chua, Iris Sin, Kam W. Fong, Melvin L. K. Chua, Hiroshi Onishi. Stereotactic body radiotherapy for early stage lung cancer—historical developments and future strategies.

Focused issue "Radiation Therapy in Palliative Oncology Care". Annals of Palliative Medicine (Ed: Charles Simone). Guest Editors: Tracy Balboni, Yolanda Tseng, Simon Lo. Indexed in PUBMED. A total of 12 papers.

Focused issue "Oligometastases- Fallacy or Real Deal?". Annals of Palliative Medicine (Ed: Charles Simone). Guest Editors: Simon Lo, Michael Milano, Tithi Biswas and Charles Simone. Indexed in PUBMED. In progress. A total of 12 papers.

Balamurugan Vellayappan, Simon S Lo, Jonathan Knisely, Kevin Shiue. The modern approaches to the management of brain metastases. Chinese Clinical Oncology. In press.

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(This is the only up-to-date comprehensive textbook in Stereotactic Body Radiation Therapy since 2004 and is available in medical libraries worldwide; this book has had **~49,400 chapter downloads** from September 2012 through May 2019 apart from sales of hundreds of hardcopies)

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National invitational lectures and others

Invited and/or refereed international or national meetings (on behalf of co-authors and co-presenters, if applicable):

Single dose vs. fractionated stereotactic radiotherapy for meningioma. Poster discussion session on November 2, 1999 in American Society for Therapeutic Radiology and Oncology meeting in San Antonio, TX

Does the extent of surgery have an impact on survival for patients with supratentorial low grade gliomas who received postoperative radiation therapy? Poster presentation in American Society for Therapeutic Radiology and Oncology meeting in October 2000 in Boston, MA

Is stereotactic radiotherapy adequate treatment for atypical and malignant meningiomas? Poster discussion in American Society of Clinical Oncology meeting in June 2002 in Orlando, FL

Radiosurgery for Meningiomas and Acoustic Neuromas
Guest Faculty at the VI Detroit Neurosurgery Symposium (Wayne State University): The Renaissance of Neurosurgery, September 13-14, 2002

Radiation therapy with or without chemotherapy for cervical cancer with periaortic lymph node metastasis. Oral presentation in American Society for Therapeutic Radiology and Oncology Annual Meeting in October 2002, New Orleans, LA.

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Post-Operative Radiotherapy for Endometrial Cancer with Pathologic Risk Factors: Patterns of Failure. Poster presentation in the American Society of Clinical Oncology Annual Meeting in June 2003, Chicago, IL.

Low Dose Gamma Knife-based Stereotactic Radiosurgery for Vestibular Schwannoma. Oral presentation in Radiological Society of North America in November 2007, Chicago, IL.

Stereotactic Radiosurgery with or without Whole Brain Radiotherapy for Patients with 2-4 Radioresistant Brain Metastases. Oral presentation in Radiological Society of North America in November 2008, Chicago, IL.

Stereotactic Radiosurgery Alone for Patients with 1-4 Radioresistant Brain Metastases. Poster presentation at American Society for Radiation Oncology in November 2009, Chicago, IL.

International Practice Patterns and Consensus on the Management of Brain Metastases. Nursing Program Faculty. American Society for Radiation Oncology on November 3, 2009, Chicago, IL. Invited.

Oncodiagnosis Panel: Detection and Treatment of Early Lung Cancer--Current Controversies and Future Directions: Oncodiagnosis (Plenary Session). Radiological Society of North America Annual Meeting, November 29, 2009, Chicago, IL. Invited.

Moderator/ Presiding Officer. Oral presentation in lung and sarcoma. Radiological Society of North America Annual Meeting, December 3, 2009, Chicago, IL. Invited.

History and Overview of Stereotactic Body Radiation Therapy
Stereotactic Body Radiation Therapy Symposium
National University Cancer Institute of Singapore
Sponsored by Singapore Radiological Society
June 21-23, 2010
Singapore
Invited.

Stereotactic Body Radiation Therapy for Early Stage Non-Small Cell Lung Cancer
Stereotactic Body Radiation Therapy Symposium
National University Cancer Institute of Singapore
Sponsored by Singapore Radiological Society
June 21-23, 2010
Singapore
Invited.

Stereotactic Body Radiation Therapy for Spinal Metastases
Stereotactic Body Radiation Therapy Symposium
National University Cancer Institute of Singapore
Sponsored by Singapore Radiological Society
June 21-23, 2010
Singapore
Invited.

Stereotactic Body Radiation Therapy for Non-Pulmonary Primary Tumors
Stereotactic Body Radiation Therapy Symposium
National University Cancer Institute of Singapore
Sponsored by Singapore Radiological Society
June 21-23, 2010
Singapore
Invited.

Stereotactic Body Radiation Therapy for Oligometastases
Stereotactic Body Radiation Therapy Symposium
National University Cancer Institute of Singapore
Sponsored by Singapore Radiological Society
June 21-23, 2010
Singapore
Invited.

Starting Stereotactic Body Radiation Therapy in a Comprehensive Cancer Center
Stereotactic Body Radiation Therapy Symposium
National University Cancer Institute of Singapore
Sponsored by Singapore Radiological Society
June 21-23, 2010
Singapore
Invited.

Radiation and Cancer Biology of Stereotactic Body Radiation Therapy
Stereotactic Body Radiation Therapy Symposium
National University Cancer Institute of Singapore
Sponsored by Singapore Radiological Society
June 21-23, 2010
Singapore
Invited.

Normal Tissue Constraints of Stereotactic Body Radiation Therapy
Stereotactic Body Radiation Therapy Symposium
National University Cancer Institute of Singapore
Sponsored by Singapore Radiological Society
June 21-23, 2010
Singapore
Invited.

Stereotactic Body Radiation Therapy for Stage I Non-Small Cell Lung Carcinoma
BIT's 3rd World Cancer Congress (WCC)-2010
Singapore
June 23, 2010

Stereotactic body radiation therapy/ Image-guided radiotherapy. Refresher Course. Radiological Society of North America Annual Meeting, December 2, 2010, Chicago, IL. Invited.

Moderator/ Presiding Officer. Radiation Oncology and Radiobiology (Pediatrics and Central Nervous System). Radiological Society of North America Annual Meeting, November 30, 2010, Chicago, IL. Invited.

Stereotactic Body Radiation Therapy for early stage non-small cell lung cancer. American Thoracic Society Annual Meeting, May 2011, Denver, CO. Invited.

Skull Base Tumors
University of Miami Comprehensive Cancer Center
Hypofractionation 2011- Scientific Concepts and Clinical Experiences
Miami Beach, FL, September 30, 2011
Invited.

Stereotactic body radiation therapy/ Image-guided radiotherapy. Refresher Course. Radiological Society of North America Annual Meeting (RSNA), December 2, 2011, Chicago, IL. Invited.

Moderator/ Presiding Officer. Radiation Oncology and Radiobiology (Lung). November 30, 2011. RSNA 2011, Chicago, IL. Invited.

Central Nervous System BOOST. Refresher Course. December 1, 2011. RSNA 2011, Chicago, IL. Invited.

SBRT for spinal metastasis
International SBRT Symposium (Supported by RTOG)
National University Cancer Institute of Singapore
March 22-24, 2012
Invited.

Complications from SBRT
International SBRT Symposium (Supported by RTOG)
National University Cancer Institute of Singapore
March 22-24, 2012
Invited.

Local therapy for oligometastases
International SBRT Symposium (Supported by RTOG)
National University Cancer Institute of Singapore
March 22-24, 2012
Invited.

Program Chair. Informational Session “Incorporation of advanced diagnostic imaging into the practice of radiation oncology”, CARROS (ACR) program, Boston, MA. October 27, 2012. Invited.

Moderator and Panelist, Scientific Panel: Innovative Approaches To Management Of Spinal Metastasis. October 28, 2012. American Society for Radiation Oncology annual meeting. Invited.

Panelist, Scientific Panel: The Role of Innovation in Palliation – Is the Benefit Worth the Cost? October 29, 2012. Boston, MA. American Society for Radiation Oncology annual meeting 2012. Invited. (Presentations cancelled due to hurricane Sandy)

Moderator and Speaker, Controversy Session: Stereotactic Radiation for Oligo-Metastasis: New Paradigm or Wishful Thinking? Special Courses. November 26, 2012,
Radiological Society of North America Annual Meeting (RSNA) 2012, Chicago, IL. Invited.

BOOST: Lung—Integrated Science and Practice (ISP) Session. November 26, 2012, RSNA 2012, Chicago, IL. Invited.

Moderator/ Presiding Officer.Radiation Oncology and Radiobiology (Lung). November 27, 2012, RSNA 2012, Chicago, IL. Invited.

Radiation Oncology and Radiobiology Afternoon CME Posters. November 27, 2012, RSNA 2012, Chicago, IL. Invited.

Stereotactic Ablative Radiotherapy for Oligometastasis. International Society of Radiosurgery Congress. Breakfast Seminar. June 19, 2013, Toronto, ON, Canada, Invited.

Session Co-Chair, Plenary Session. Spines. International Society of Radiosurgery Congress. June 19, 2013, Toronto, ON, Canada, Invited.

Program Chair. Informational Session "ACR Appropriateness Criteria- A Useful Practice Tool", CARROS (ACR) program, Atlanta, GA, September 21, 2013.

Panelist, Scientific Panel: Radiosurgery for Metastases – Improved Patient Care or Unnecessary Cost? September 25, 2013, American Society for Radiation Oncology (ASTRO) annual meeting 2013, Atlanta, GA.

Clinical Aspects of LINAC-based SBRT. October 12, 2013, AAPM Ohio Valley and Ohio-Penn Chapters Fall Meeting 2013, Beachwood, OH. Invited.

Moderator/ Presiding Officer.Radiation Oncology and Radiobiology (CNS). December 2, 2013, Radiological Society of North America Annual Meeting (RSNA) 2013, Chicago, IL. Invited.

BOOST: Head and Neck—Integrated Science and Practice (ISP) Session. December 2, 2013, RSNA 2013, Chicago, IL. Invited.

Session Chair and Panelist. Role of Stereotactic Ablative Radiotherapy (SABR) and Interventional Radiology in the Management of Oligometastases. Refresher Course. December 3, 2013. RSNA 2013, Chicago, IL. Invited.

Leksell Gamma Knife Meeting
Moderator
Breakfast Seminar
Spinal Radiosurgery
May 15, 2014
New York City, NY
(Declined this invitation due to time conflict)

Showdown session: Tumor Radiobiology: Does Conventional Wisdom Hold for SRS/SBRT?
Radiosurgery Society Biannual Meeting
May 9, 2014
Minneapolis, MN

Invited Speaker (Together with Drs. Ben Slotman, Arjun Sahgal, Bin Teh)
Strategies to mitigate complications from SBRT
Educational session.
American Society for Radiation Oncology (ASTRO) Annual Meeting, September 17, 2014, San Francisco, CA

Co-moderator
Oral scientific presentation: Brain and spinal metastases
American Society for Radiation Oncology (ASTRO) Annual Meeting, September 17, 2014, San Francisco, CA

A Multi-National Report on Technical Factors of Stereotactic Body Radiotherapy for Oligometastases. Poster presentation at American Society for Radiation Oncology Annual Meeting, September 15, 2014, San Francisco, CA

Program Chair. Informational Session "Cost-effectiveness of cancer therapy with special focus on radiotherapeutic procedures for breast and prostate cancer", pre-ASTRO CARROS (ACR) program, September 13, 2014, San Francisco, CA

Course Director and Moderator
BOOST: Lung Cancer
Case-based Review
December 1, 2014
RSNA 2014, Chicago, IL

Moderator
BOOST: Lung Cancer
Integrated Science and Practice
December 1, 2014
RSNA 2014, Chicago, IL

Course Director and Moderator
BOOST: Lung Cancer
Anatomy and Contouring
December 1, 2014
RSNA 2014, Chicago, IL

Session Chair and Panelist. Role of Stereotactic Ablative Radiotherapy (SABR) and Interventional Radiology in the Management of Oligometastases. Refresher Course. December 2, 2014. RSNA 2014, Chicago, IL. Invited.

Invited presenter
"A Phase 2 Randomized, Double Blind, Placebo-Controlled Clinical Trial of D-methionine For the Prevention of Cisplatin-Induced Ototoxicity and Other Side Effects in Patients with Gynecological (Ovarian, Endometrial, Cervical) and Head and Neck Cancer"
NRG Oncology Meeting
Cancer Prevention and Control Committee Meeting
February 6, 2015
San Diego, CA

Invited presenter
"A Phase 2 Randomized, Double Blind, Placebo-Controlled Clinical Trial of D-methionine For the Prevention of Cisplatin-Induced Ototoxicity and Other Side Effects in Patients with Gynecological (Ovarian, Endometrial, Cervical) and Head and Neck Cancer"
NRG Oncology Meeting
Cervical Cancer Work Group Meeting
February 6, 2015
San Diego, CA

Invited Speaker
IAEA Stereotactic Body Radiotherapy Symposium
Sydney, Australia
July 2015
Declined due to time conflict

Invited Speaker
Spinal SRS
American Radium Society
Hawaii
April 2015
Declined due to time conflict

Invited Speaker
SBRT for gastrointeestinal malignancies
Yashoda International Cancer Conference: Recent Advances and Newer Horizons
Hyderabad, India
January 24- 25, 2015
Declined due to time conflict

Invited Speaker
Radiobiology of SRS/ SBRT and Strategies to mitigate risk of complication of SBRT
Pre-European Society for Radiotherapy and Oncology (ESTRO) Stereotactic Body Radiotherapy Symposium
Barcelona, Spain
April 24, 2015

Invited Speaker
SBRT for bone metastasis
Pre-European Society for Radiotherapy and Oncology (ESTRO) Stereotactic Body Radiotherapy Symposium
Barcelona, Spain
April 24, 2015

Invited Speaker
The State of Brain and CNS Research
Continuing Education Session
Radiotherapy Research: Building on the Past and Looking to the Future
Amercian College of Radiology
Washington, DC
May 17, 2015

Distinguished Speaker
Management Of Spine Mets In The Era Of Spine SRS
Session Chair, Oligometastasis in 2015 - Fact or Myth?
Singapore Radiological Society
Annual General Meeting
Singapore
May 14-15, 2015

Distinguished Speaker
SRS Should Be First Line For Oligo Brain Metastasis
Session Chair, Oligometastasis in 2015 - Fact or Myth?
Singapore Radiological Society
Annual General Meeting
Singapore
May 14-15, 2015

Distinguished Speaker
Integration Of Systemic Agents With SRS In Oligometastatic Disease

Session Chair, Oligometastasis in 2015 - Fact or Myth?
Singapore Radiological Society
Annual General Meeting
Singapore
May 14-15, 2015

Invited Speaker
CT and MRI Guided Radiosurgery Procedures
North American Gamma Knife Consortium Meeting
Cleveland, OH
June 27, 2015

Invited presenter
"A Phase 2 Randomized, Double Blind, Placebo-Controlled Clinical Trial of D-methionine For the Prevention of Cisplatin-Induced Ototoxicity and Other Side Effects in Patients with Gynecological (Ovarian, Endometrial, Cervical) and Head and Neck Cancer"
NRG Oncology Meeting
Head and Neck Core Committee Meeting
July 17, 2015
Denver, CO

Invited Speaker (Together with Drs. Ben Slotman, Arjun Sahgal, Bin Teh)
Strategies to mitigate complications from SBRT
Educational session.
American Society for Radiation Oncology (ASTRO) Annual Meeting 2015
San Antonio, TX
October 21, 2015

Invited Speaker (On behalf of Dr. Arjun Sahgal)
Strategies to mitigate complications from SBRT: Spine
Educational session.
American Society for Radiation Oncology (ASTRO) Annual Meeting 2015
San Antonio, TX
October 21, 2015

Co-moderator
Oral scientific presentation: Brain SRS
American Society for Radiation Oncology (ASTRO) Annual Meeting 2015
San Antonio, TX
October 19, 2015

Session Chair and Panelist
Image-guided stereotactic body radiotherapy (SBRT) for spinal metastases- Spinal imaging, target delineation and post-SBRT response evaluation
Refresher Course
RSNA 2015
Chicago, IL
December 1, 2015

Moderator
Fundamentals of Imaging for the Radiation Oncologist
Refresher course

RSNA 2015
Chicago, IL
November 29, 2015

Keynote Speaker
BOOST: CNS Tumors
Integrated Science and Practice
RSNA 2015
Chicago, IL
December 1, 2015

Invited speaker
Toxicities associated with SBRT and strategies to avoid them
Langendorff Congress 2015
University of Freiberg, Germany
October 10, 2015

Invited speaker
Development of SBRT in the past decade- Global perspective
University of North Carolina/ Accuray User Meeting
November 13, 2015

Invited speaker
Prospective clinical trials of SBRT for gynecologic malignancies- University Hospitals Seidman Cancer Center/ Case Comprehensive Cancer Center experience
University of North Carolina/ Accuray User Meeting
November 13, 2015

Invited speaker
Response assessment after stereotactic body radiotherapy for spinal metastasis: a report from the SPIne response assessment in Neuro-Oncology (SPINO) group
NRG Oncology Semi-Annual Meeting
Functional Imaging Work Group
Atlanta, Georgia
January 22, 2016

Invited Speaker
Safe and effective delivery of spine SBRT: Webinar (Invited)
Radiosurgery Society (RSS)
February 4, 2016

Invited Speaker
Safe and effective delivery of spine SBRT: Webinar (Invited)
American Association of Medical Dosimetrists (AAMD)
April 13, 2016

Invited speaker
Precision Radiotherapy Technologies in Management of Brain Metastases
American Society of Clinical Oncology
Palliative Care in Oncology Symposium
San Francisco, CA
September 10, 2016

Presenter
Consensus Statement from the International Stereotactic Body Radiotherapy Consortium for Head and Neck Carcinoma - Patient Selection and Pre- and Post-SBRT Evaluation
Poster Presentation
American Society for Radiation Oncology (ASTRO) Annual Meeting 2016
Boston, MA
September 26, 2016

Invited speaker (Together with Drs. Ben Slotman, Arjun Sahgal, Bin Teh)
Strategies to mitigate complications from SBRT
Educational session (SA-CME)
American Society for Radiation Oncology (ASTRO) Annual Meeting 2016
Boston, MA
September 27, 2016

Invited speaker
Spinal SBRT Fundementals and Special Considerations: Current Research and Future Directions
Educational session.
American Society for Radiation Oncology (ASTRO) Annual Meeting 2016
Boston, MA
September 28, 2016

Discussant
CNS tumors: e-poster
Scientific session
American Society for Radiation Oncology (ASTRO) Annual Meeting 2016
Boston, MA
September 25, 2016

Invited speaker
Why SBRT and What is State of the Art
Hands-On SBRT Workshop
MTMI
Seattle, WA
October 14, 2016

Invited speaker
Future Directions of SBRT
Hands-On SBRT Workshop
MTMI
Seattle, WA
October 16, 2016

Invited expert
Meeting the expert session
Hands-On SBRT Workshop
MTMI, Seattle, WA
October 16, 2016

Invited speaker
Golden age of radiotherapy

Hong Kong International Oncology Symposium
Hong Kong SAR
October 28, 2016

Invited speaker
Brain and spine radiosurgery
Hong Kong Neurosurgical Society
Hong Kong SAR
October 31, 2016

Course Director and Moderator
BOOST: Lung Cancer
Case-based Review
RSNA 2016, Chicago, IL

Moderator and Speaker
Controversy Session: Is It Time to Put Whole Brain Radiotherapy to Pasture? What's New in the Treatment of Limited Brain Metastases
RSNA 2016, Chicago, IL

Moderator
Imaging Evaluation, Target Delineation and Response Evaluation for Skull Base and Spinal Stereotactic Radiosurgery/Radiotherapy
Refresher course (SA-CME)
RSNA 2016, Chicago, IL

Moderator
Stereotactic body radiotherapy for renal cell carcinoma (Webinar)
Radiosurgery Society
December 13, 2016

Speaker
Optimal imaging for disease evaluation, target delineation and post-treatment response evaluation for stereotactic body radiotherapy for spinal metastases (Webinar)
Radiosurgery Society
January 17, 2017

Moderator
Long-Term Outcome of SBRT in Non-Small Cell Lung Cancer: Indiana University Experience (Webinar)
Radiosurgery Society
October 10, 2017

Faculty
eContouring for Pediatric and SBRT/Spine Cancer
American Society for Radiation Oncology (ASTRO) Annual Meeting 2017
San Diego, CA
September 24, 2017

Faculty
Poster Walk with a Professor
Radiosurgery Society Meeting
Las Vegas, NV

November 3, 2017

Moderator (with Markus Kufeld)
SRS for Spine – Oral Abstract Session
Radiosurgery Society Meeting
Las Vegas, NV
November 2, 2017

Moderator
Lung BOOST- Case Based Review
November 28, 2017
RSNA 2017, Chicago, IL

Moderator
Lung BOOST- The Confluence of Diagnostic Radiology and Radiation Oncology
November 28, 2017
RSNA 2017, Chicago, IL

Speaker
Oncodiagnosis Panel- Spinal Metastasis
November 26, 2017
RSNA 2017, Chicago, IL

Invited Speaker
Radiosurgical Contouring and Dosimetry, and Complication Avoidance: Conventional Radiation vs. Radiosurgery
8th Annual Multimodal Treatment of Spinal Tumors- Seattle Science Foundation
Seattle, WA
April 14, 2018

Invited Speaker
Spine Metastasis: Conventional Radiation Therapy vs. Radiosurgery
8th Annual Multimodal Treatment of Spinal Tumors- Seattle Science Foundation
Seattle, WA
April 14, 2018

Invited Panelist (Jens R. Chapman, M.D. and Ehud Mendel, M.D. vs. Simon S. Lo, M.D. and Peter Gerszten, M.D., M.P.H., FACS)
Battle of the Surgeons: Case Discussions and Debates: Radiosurgery vs. Surgery
8th Annual Multimodal Treatment of Spinal Tumors- Seattle Science Foundation
Seattle, WA
April 14, 2018

Invited panelist/ speaker
Expert Panel: Challenging Cases in Palliation
Palliative Radiation in the Modern Era: Evidence and Strategies for Best Practice
New York, NY
April 20, 2018

Invited panelist/ speaker
Expert Panel: Immunotherapy + Radiation: Issues of Safety, Synergy, and Pseudoprogression
Palliative Radiation in the Modern Era: Evidence and Strategies for Best Practice
New York, NY

April 20, 2018

Moderator
(Speakers: Stephanie Combs and Hany Soliman)
Postoperative SRS/SRT to the Surgical Cavity after Brain Metastases Resection
Radiosurgery Society Webinar
June 5, 2018

Invited speaker
SBRT for renal cell carcinoma
Hong Kong SBRT study group (HKSBRTSG)
Hong Kong SAR
June 30, 2018

Invited speaker
Safe Delivery of SBRT: Normal Tissue Tolerance and Interaction with Systemic Therapies
Hong Kong SBRT study group (HKSBRTSG)
Hong Kong SAR
June 30, 2018

Discussant
PRO Scientific Session
ASTRO
San Antonio, TX
October 20, 2018

Invited faculty/speaker
PRO- CNS
Updates In The Management of Brain Metastases
ASTRO
San Antonio, TX
October 21, 2018

Invited faculty/speaker
CNS/ Spine SBRT E-contouring
ASTRO
San Antonio, TX
October 22, 2018

Invited faculty/speaker
Scientific Panel- Use of Advanced Technologies in Palliative Care: a Brave New World or a Costly Mistake?
Appropriate use of advanced technologies
ASTRO
San Antonio, TX
October 24, 2018

International Distinguished Speaker
The changing landscape of brain metastasis management
ICON Group
Melbourne, Australia
November 7, 2018

International Distinguished Speaker
Plenary Session: Contemporary advances in the management of brain metastases
Stereotactic Interest Group of Australasia (SIGA) Inaugural Meeting
Melbourne, Australia
November 8, 2018

International Distinguished Speaker
Stereotactic Radiosurgery for large brain metastases – Should we do it alone, before surgery or after surgery?
Stereotactic Interest Group of Australasia (SIGA) Inaugural Meeting
Melbourne, Australia
November 8, 2018

International Distinguished Speaker
The role of spine SBRT in the palliative oncology
Stereotactic Interest Group of Australasia (SIGA) Inaugural Meeting
Melbourne, Australia
November 8, 2018

Panelist
What radiosurgery system will best suit the needs of my department?
Stereotactic Interest Group of Australasia (SIGA) Inaugural Meeting
Melbourne, Australia
November 8, 2018

Special Guest Panelist (Together with Drs. Albert Koong, Brian Kavanagh, Paul Keall, and Fiona McDonald)
Challenging cases in oligometastases
Peter MacCallum Cancer Centre Stereotactic Ablative Radiotherapy (SABR) Symposium
Melbourne, Australia
November 9, 2018

Moderator
Lung BOOST- Case-based review
November 2018
RSNA 2018, Chicago, IL

Faculty (together with Drs. Kristin Redmond and William Yuh)
CNS BOOST- E-contouring for spine SBRT
November 2018
RSNA 2018, Chicago, IL

Speaker (Together with Dr. Kristin Redmond from Johns Hopkins University)
Special ASTRO webinar
E-contouring: Spine SBRT and CNS
Invited by ASTRO
February 26, 2019

Invited faculty (Declined due to time conflict)
IAEA SBRT course
Hiroshima, Japan
February 2019

Invited speaker (Declined due to time conflict)

Langendorff Symposium
Freiburg, Germany
March 2019

Panel Co-Chair and Speaker
SRS/SBRT: Building Collaborative Teams – Exchanging Experiences and Addressing Challenges
Building a spine oncology program from scratch
Radiosurgery Society Meeting 2019
San Diego, CA
March 22, 2019

Co-Moderator with Dr. Najeeb Mohideen
Showdown Debate between Dr. Shankar Siva and Dr. Robert Aboussaly
SBRT vs Focal Ablation Therapy for Primary Renal Cell Carcinoma – Let the Madness Begin
Radiosurgery Society Meeting 2019
San Diego, CA
March 22, 2019

Speaker
ARS Bone Metastasis Appropriate Use Committee Report
American Radium Society Meeting
Dana Point, CA
April 7, 2019

Panel Chair and Speaker (Panelists: Simon S Lo, E Antonio Chiocca, Tracy Batchelor, Andrew Sloan)
Bringing New and Innovative Glioblastoma Treatments to Daily Practice
American Society of Clinical Oncology Annual Meeting ‘
Chicago, IL
June 3, 2019

Faculty (Together with Drs. Kristin Redmond and Gregory Videtic)
E-contouring for SBRT for oligometastases
ASTRO Annual Meeting
Chicago, IL
September 15, 2019

Discussant
Scientific Session: Palliative 1
ASTRO Annual Meeting
Chicago, IL
September 16, 2019

Panelist (Together with Drs. Yolanda Tseng, Candice Johnstone, Peter Hoskin, Alyssa Fairchild)
Stat Rads! Turn the Beam On! Challenging Palliative Radiation Emergencies
ASTRO Annual Meeting
Chicago, IL
September 17, 2019

Invited speaker
SRS for large brain metastases- Preop, postop or no op?
Hong Kong International Oncology Symposium
Hong Kong SAR

October 26, 2019

Moderator (Speakers: Shankar Siva and Rodney Ellis)
SBRT for primary renal cell carcinoma
Radiosurgery Society Webinar
November 6, 2019

Panelist
Oncodiagnosis Panel: Renal Cell Carcinoma
RSNA Annual Meeting
Chicago, IL
December 2019

Panelist
Lung BOOST- Case-based review
RSNA Annual Meeting
Chicago, IL
December 2019

Panelist (Together with Tithi Biswas and Smith Apisarnthanarax)
Post-Stereotactic-Radiation Imaging Assessment: Spine & GI SBRT
Radiosurgery Society Webinar
December 12, 2019

Invited speaker
Post-SBRT imaging evaluation- Spinal metastasis
Radiosurgery Society Meeting
Washington, DC
June 2020 (Virtual Meeting)

Invited panelist and speaker
SRS/ SBRT in the time of COVID-19
Radiosurgery Society Webinar
April 21, 2020
(743 attendees online)

Invited speaker (together with Dr. Kristin Redmond from Johns Hopkins)
Strategies to Guide Safe Delivery of Spinal SBRT
Radiosurgery Society Webinar
June 30, 2020

Invited speaker
Managing adverse effects of AVM radiosurgery
4th Biennial Radiosurgery Research and Education Meeting
International Radiosurgery Research Foundation (IRRF)
Uniondale, New York
June 20, 2020

Invited speaker (together with Drs. Shankar Siva, Alexander Louie, and Nicholas Zaorsky)
The Role of Stereotactic Radiotherapy in Renal Cell Carcinoma - Radioresistance or Resistance to Radiate?
ASTRO Annual Meeting
Miami Beach, FL

October 2020

Invited speaker
Stereotactic Body Radiotherapy for Spinal Metastases- The Current State of Affairs and Future Directions
Hong Kong International Oncology Symposium
November 8, 2020

Invited panelist (together with S. R. Digumarthy, J.D. Patel, D. Johnstone, F. Kong)
BOOST: Lung, Mediastinum, Pleura—Case-based Multidisciplinary Review (Interactive Session)
RSNA Annual Meeting
Chicago, IL
November 2020

Keynote Guest Speaker
Singapore Radiation Oncology Annual Dinner Symposium
December 17, 2020

Speaker
Radiosurgery Society Distinction in Stereotactic Radiotherapy
ACRO Annual Meeting
February 27, 2021

Moderator (Speakers: Arjun Sahgal and Kristin Redmond)
Webinar: The road to establishing SBRT as the standard of care for limited spinal metastases
Radiosurgery Society
April 27, 2021

Faculty speaker
Sparing of the spinal cord: Limitations in treatment planning
Spine Tumor Academy
Switzerland (Virtual)
April 24, 2021

Invited Faculty
Postoperative Spine: Aim before your shoot- Don't shoot from the hips!/ Expert Wrap Up/ Panel Discussion
RadoncAsia Singapore On-Target (SPOT) Contouring Workshop Series 2021
August 14-15, 2021

Moderator, Panel Chair and Speaker
Judicious use of SRS/ HSRT for large brain metastasis
ASTRO
October 2021

Invited Speaker
Advanced raditotherapy- A brave new world or a costly mistake?
Hong Kong International Oncology Symposium
November 2021

Panel Lead
Lung Cancer: Case-Based Review
RSNA
November 29, 2021

Moderator
Scientific Session: Radiation Oncology (CNS/ Head and Neck)
RSNA
November 30, 2021

Moderator
Scientific Session: Radiation Oncology (Lung)
RSNA
December 2, 2021

Panelist (Co-Panelists: Stan Benedict, Brain Lally, Jaroslaw Hepel, and Fraser Cobb)
Distinction in Practice in SRT Accreditation Program
ACRO/ Radiosurgery Society
Recorded on December 7, 2021

Invited Faculty
Spinal Oncology- Radiation Oncology Perspective
ASSR Spine Oncology webinar
December 18, 2021

Co-moderator with Dr. Percy Lee
Showdown debate: Single fraction vs Multifraction SBRT for Spinal Metastases
Radiosurgery Society Meeting
March 5, 2022
San Diego

Speaker
Managing the Prevention of SRS/ SBRT-Induded Toxicities: SBRT for Spinal Lesions
Radiosurgery Society Meeting
March 5, 2022
San Diego

Speaker
Performance and Quality Imporvement Session
Radiosurgery Society Meeting
March 6, 2022
San Diego

Invited Special Guest Speaker (Invited by Profeessor Yasushi Nagata)
Japanese Society for Radiation Oncology
November 10-12, 2022
Hiroshima, Japan

Courses/ educational sessions developed for national meetings:

Radiological Society of North America

Radiological Society of North America 2015 (together with Dr. Stephanie Terezakis from Johns Hopkins University):
5 refresher courses in radiation oncology
1 refresher course in radiation safety (both diagnostic radiology and radiation oncology)
1 Controversy Session

1 Oncodiagnosis Panel
1 CNS BOOST contouring session
Total: 9 courses

Radiological Society of North America 2016 (together with Dr. Stephanie Terezakis from Johns Hopkins University and Dr. Christina Tsien from Washington University):
5 refresher courses in radiation oncology
1 Controversy Session
1 Oncodiagnosis Panel
1 Lung BOOST Case Based Review
1 Lung BOOST Anatomy and Contouring
Total: 9 courses

Radiological Society of North America 2017 (together with Dr. Christina Tsien from Washington University):
5 refresher courses in radiation oncology
2 Controversy Sessions
1 Oncodiagnosis Panel
1 Lung BOOST Case Based Review
1 Lung BOOST Anatomy and Contouring
1 Lung BOOST Didactic
Total: 11 courses

Radiological Society of North America 2018 (together with Dr. Christina Tsien from Washington University):
5 refresher courses in radiation oncology
One Controversy Session
1 Oncodiagnosis Panel
1 Lung BOOST Case Based Review
1 Lung BOOST Anatomy and Contouring
1 Lung BOOST Didactic
1 BOOST Spinal SBRT e-contouring
Total: 11 courses

Radiological Society of North America 2019 (together with Dr. Christina Tsien from Washington University):
5 refresher courses in radiation oncology
One Controversy Session
1 Oncodiagnosis Panel
1 Lung BOOST Case Based Review
1 Lung BOOST Anatomy and Contouring
1 Lung BOOST e-contouring
Total: 10 courses

Radiological Society of North America 2020
1 Oncodiagnosis Panel
1 Lung BOOST Case Based Review
Total: 2 courses

Radiological Society of North America 2021 (together with Dr. Sung Kim, Anna Shapiro and Suresh Mukherji)
7 Case-Based reviews
3 Oncodiagnosis Panels
3 Scientific Sessions
Total: 13 courses

American Society of Clinical Oncology

American Society of Clinical Oncology 2019
CNS track
5 educational courses

American Society of Clinical Oncology 2020
CNS track
5 educational courses

American Society of Clinical Oncology 2021
CNS track
5 educational courses

Radiosurgery Society

Radiosurgery Meeting 2017
Member of Planning Committee

Radiosurgery Meeting 2019
Member of Planning Committee

Radiosurgery Meeting 2020
Member of Planning Committee

Radiosurgery Meeting 2021
Member of Planning Committee

Radiosurgery Meeting 2022
Member of Planning Committee

Invited and/or refereed local regional meetings (on behalf of co-authors and co-presenters, if applicable):

A comparison of stereotactic radiosurgery and fractionated stereotactic radiotherapy for the treatment of meningiomas: A seven year institutional experience at University of Minnesota (Oral presentation in the Minnesota Radiological Society Meeting on April 9, 2000).

Surgery impacts on survival of patients with low grade glioma treated with postoperative radiation therapy (Oral presentation in the Minnesota Radiological Society Meeting on April 8, 2001)

Is stereotactic radiotherapy adequate treatment for atypical and malignant meningiomas? (Oral presentation in Minnesota Radiological Society Meeting on April 6, 2002)

Radiosurgery for meningiomas and acoustic neuromas (Guest faculty at the VI Detroit Neurosurgery Symposium: The Renaissance of Neurosurgery, September 13-14, 2002)

Hodgkin Lymphoma- Role of Radiation Therapy (Invited speaker at Chicago Radiological Society, January 15, 2004)

Modern Radiation Techniques and their Application in Brain Tumors. 1st Annual Neuro-oncology Symposium: Recent Advances in high Grade Gliomas and the Impact on Treatment. Arthur G. James Cancer Hospital. September 16, 2006.

Extracranial Stereotactic Radiotherapy.
Lung Cancer Care for 21st Century. Ohio State University Medical Center. March 3, 2007.

Advanced Radiation Therapy Modalities
Invited speaker for OSU Medical Service Board
October 18, 2007

Stereotactic Body Radiation Therapy.
Southern Ohio Cancer Center Grand Round
October 19, 2007

Spinal Metastases- Radiotherapy Perspective
Spine and Bone Tumor Symposium
OSU comprehensive cancer center
May 3, 2008

American Society of Clinical Oncology review
Arthur G. James Cancer Hospital
June 21, 2008

Stereotactic Body Radiation Therapy for Early Stage Non-Small Cell Lung Cancer
Today's Multidisciplinary Approach to Lung Cancer
St. Vincent's Health System, Erie, PA
An affiliate of University of Pittsburgh Medical Center
May 16, 2009

American Society for Radiation Oncology (ASTRO) Review
Case Comprehensive Cancer Center (Joint Cleveland Clinic Foundation/ UH Seidman Cancer Center)
November 15, 2014

CNS and Radiosurgery Update
Washington State Radiological Society Annual Meeting
November 5, 2016

Media

https://www.dispatch.com/article/20080120/news/301209867

LA times- http://articles.latimes.com/2007/dec/31/health/he-unreal31

Reuters Health- https://www.journalofclinicalpathways.com/news/stereotactic-radiosurgery-after-complete-resection-brain-mets-improves-outcomes

https://www.doximity.com/doc_news/v2/entries/19873369

https://physicsworld.com/a/how-has-covid-19-impacted-the-provision-of-radiation-therapy/

https://www.astro.org/ASTRO/media/ASTRO/AffiliatePages/arro/PDFs/ARROCase_SpineSBRT.pdf?utm_source=MagnetMail&utm_medium=email&utm_term=INSERT_EMAIL&utm_content=INSERT_MESSAGE_NAME&utm_campaign=INSERT_MESSAGE_SUBJECT

Health Technology Clinical Committee Conflict of Interest Disclosure

Washington State Health Care Authority

As stewards of public funds, the practicing clinicians who serve (or apply to serve) on the Committee strive to uphold the highest standards of transparency and impartiality. Identifying financial, professional, and other interests contribute to the effective management of perceived, potential, and/or real conflicts of interest/bias that could affect Committee determinations. (WAC 182-55)

This Conflict of Interest form must be completed by an applicant for appointment to the State of Washington Health Technology Clinical Committee (HTCC) or appointment to any of its subcommittees or work groups.

A member of the HTCC or any of its subcommittees or work groups may not participate in discussions or deliberations of any class of drugs, health technology, or any agenda item for which a conflict of interest is identified and may not vote on any such matter.

If a conflict of interest is so great as to make it difficult for any member to participate meaningfully in the work of the HTCC, that member may be asked to resign.

1 Applicant information

First name: Middle initial:

Last name:

Phone number: Email:

2 Financial interests

Disclose your financial interests and relationships occurring over the last twenty-four months.

List amounts totaling $1,000 or more from a single source.

Indicate the category of financial interest/relationship by referring to the disclosure categories below. Select the letter corresponding to your financial interest(s). You may indicate multiple categories.

Indicate the source and date of the financial interest. For each chosen category, include date and if your activities are ongoing.

Indicate the recipient. Family: spouse, domestic partner, child, stepchild, parent, sibling (his/her spouse or domestic partner) currently living in your home.

Financial interest categories

Use these categories to indicate the nature of the financial interest:

A. Payment from parties with a financial or political interest in the outcome of work as part of your appointment or activity.

B. Employment including work as an independent contractor, consultant, whether written or unwritten.

C. Ownership or owning stock (stock, options, warrants) or holding debt or other significant proprietary interests or investments in any third party that could be affected.

D. Receiving a proprietary research grant or receiving patents, royalties, or licensing fees.

E. Participating on a company's proprietary governing boards.

F. Participating in a speakers bureau.

G. Receiving honoraria.

Please list your financial interests on the next page. Attach additional sheets if necessary.

Financial interest disclosures

Category (A-G)	Source of income and date	Amount	Recipient	
G	Japanese Society for Radiation Oncology	US$1,000	✓ Self	Family
			Self	Family
			Self	Family
			Self	Family
			Self	Family
			Self	Family
			Self	Family

3 Other interests

Please respond to the following questions. Disclose all interests that may apply to topics covered in upcoming meetings.

Have you authored, coauthored, or publicly provided an opinion, editorial, or publication related to any meeting topic? Topics(s):

Yes. I have published numerous papers and edited textbooks on SBRT for various sites including lung, liver, kidney, spine, prostate, adrenal, head and neck and gynecologic cancers.

Are you involved in formulating policy positions or clinical guidelines related to any meeting topic? Topics(s):

Yes, I have led or participated in multiple clinical guidelines for SBRT for various disease sites and have participated in the renewal of the American Society for Radiation Oncology (ASTRO) Model Policy for SBRT.

Could a coverage determination based on a Committee decision conflict with policies you have promoted or are obliged to follow? Topic(s):

No.

4 Signature

I have read the Conflict of Interest Disclosure form. I understand the purpose of the form and agree to the application of the information to determine conflicts of interest. The information provided is true and complete as of the date the form was signed. If circumstances change, I am responsible for notifying committee staff in order to amend this disclosure. I will complete this form annually by July 1st of each year of committee membership.

To sign this request, do not use the "Fill & Sign" function; instead, simply click in the signature field to add your signature.

Signature [redacted]

Date 11/15/2022

Submit

or return form to **shtap @hca.wa.gov**

Or mail to:
Health Technology Assessment Program
Washington State Health Care Authority
P.O. Box 42712
Olympia, WA 98504-2712

Health Technology Clinical Committee Application for Membership

Washington State Health Care Authority

Clear form

1 Contact information

First name:

Middle initial:

Last name:

Address:

Phone number:

Best method, time to reach you:

Email:

Today's date
11/15/2022

2 Personal information (optional)

Gender:

✔ Male ☐ Female ☐ X/non-binary[1]

Pronouns (select all that apply)

☐ She/her ✔ He/him ☐ They/them ☐ Other (subj./obj.):

Race or Ethnicity

☐ American Indian or Alaska Native

✔ Asian or Pacific Islander American

☐ Black/ African American

☐ Latino, Hispanic, Spanish

☐ White/ Caucasian

☐ Other:

3 Professional training

Education (list degrees):
MB, ChB

Health care practitioner licenses:
Physician

Professional affiliations:

Board certifications, formal training, or other designations:
American Board of Radiology (Rad Onc)

Current position (title and employer):
Professor of Radiation Oncology, University of Washington

Current practice type and years in practice:
UWMC, 6 years

Total years as an active practitioner:
21

Location of practice (city):
Seattle, WA

1 *Non-binary (X) is an umbrella term used to describe those who do not identify as exclusively male or female. This includes but is not limited to people who identify as genderqueer, gender fluid, agender, or bigender.*

4 Experience

Provide a brief explanation (up to 150 words each) addressing the following:

1) Why you would like to serve on the clinical committee;

By serving on this clinical committee, I shall be able to utilize my expertise in radiation oncology, particularly advanced radiotherapy techniques, to help assess health technology pertaining to radiotherapy for various disease conditions.

2) The value of informing health policy decisions with scientific evidence, including any examples incorporating new evidence into your practice;

Best clinical practice is guided by scientific evidence. Over the past 21 years working as academic radiation oncologist, I have always had first hand access to the newest technologies. However, it is only after extensive research that a particular type of technology confers benefits in patient outcomes that it will be be incorporated into regular practice. One good example is stereotactic body radiotherapy (SBRT) for medically inoperable non-small cell lung cancer. Twenty years ago, most patients who received SBRT for lung cancer in a clinical trial setting. With more data emerging from high quality large retrospective studies, single arm prospective trials, and randomized phase III trials, SBRT is proven to be equivalent to surgery and superior to conventional radiotherapy. Currently, it has been fully incorporated into clinial practice.

3) How your training and experience will inform your role on the committee

I have started to study and perform SBRT in 2004, at which time there were only a handful of centers in the US performing such treatment. I have built or led SBRT programs in 3 NCI designated Comprehensive Cancer Centers (Arthur G. James Cancer Hospital, Case Comprehensive Cancer Center and UW). Internationally and nationally, I have helped numerous centers build SBRT programs. I have participated or led numerous guidelines pertaining to SBRT and am one of the few taskforce members drafting the American Society for Radiation Oncology Model Policy for SBRT. I am also the Medical Director of the National Distinction in Practice in Stereotactic Radiotherapy Accreditation Program with Radiosurgery Society (non-profit professional organization). My extensive experience in this area will enable me to assess the appropriateness of the use of advanced radiotherapy technologies.

4) Treating populations that may be underrepresented in clinical trials: women, children, elderly, or people with diverse ethnic and racial backgrounds, including recipients of Medicaid or other social safety net programs?

When advanced radiotherapy techniques that are proven to be beneficial for certain disease conditions, they will be incorporated into regular practice and will be accessible to underrepresented population both in a clinicla trial and an off-trial setting.

5 Ability to serve

Are you able to participate in all-day meetings, an estimated six times per year? ☐ Yes ☑ No

Are you willing to commit to the responsibilities of a committee member, including:

- Attending meetings prepared for the topics of the day;
- Actively participating in discussions;
- Making decisions based on the evidence presented and the public interest[1]? ☑ Yes ☐ No

Could you, or any relative, benefit financially from the decisions made by the HTCC? ☐ Yes ☑ No

6 References

Provide three professional references:

1.

First name: Edward
Last name: Kim
Relationship: Medical Director and colleague
Title: Associate Professor and Medical Director of Rad Onc
Contact email: edykim@uw.edu
Phone number: 206-598-4100

2.

First name: Upendra
Last name: Parvathaneni
Relationship: Colleague
Title: Professor of Radiation Oncology
Contact email: upendra@uw.edu
Phone number: 206-598-4100

3.

First name: Smith
Last name: Apisarnthanarax
Relationship: Colleague
Title: Professor of Radiation Oncology
Contact email: apisarn@uw.edu
Phone number: 206-606-7318

Please return:

✓ Completed application ✓ curriculum vitae ✓ **conflict of interest disclosure**

Submit to send via email to: **shtap@hca.wa.gov**

OR mail to:
Health Technology Assessment Program
Washington State Health Care Authority
P.O. Box 42712
Olympia, WA 98504-2712

1 *Detailed in Washington Administrative Code (WAC) and committee bylaws*

Washington State Health Care Authority

Agency medical director comments

Stereotactic Body Radiation Therapy

Sophie Cain Miller, MD MPH
Medical Officer for Medicaid
WA Health Care Authority

May 19, 2023

Washington State Health Care Authority

Radiation Therapy

- **External beam radiation therapy**
  - Utilizes machine to aim high doses of radiation at cancer cells
  - Local treatment to specific areas of tumor
- Internal radiation therapy
  - Source of radiation is put inside body (seeds, capsules)
  - Also known as “brachytherapy”

Stereotactic Body Radiation Therapy (SBRT)

- Radiation treatment modality
- High anatomic targeting accuracy
  - Target lesion (tumor) is localized in a three dimensional system
  - Imaging modalities utilized for planning: CT, MRI, PET
- High doses of precise radiation in fewer fractions
  - One to five sessions (fractions)
  - 6-30Gy

Washington State Health Care Authority

Agency medical director concerns - overall

Safety = medium

Efficacy = high

Cost = high

Note: concerns noted above from initial review in 2012

Previous HTCC decisions

- 2012 evidence review of stereotactic radiosurgery (SRS) and SBRT
- Coverage for:
  - Central nervous system primary and metastatic tumors
  - Cancers of the spine and paraspinal structures
  - **Inoperable Stage 1 non small cell lung cancer**
- All evaluations should include a multidisciplinary team analysis including surgical input

Current State Agency Policy on SBRT

- Uniform Medical Plan
- Medicaid
- Labor and Industries

Follow 2012 HTCC decision

SBRT:
HTCC Re-review Rationale

- Updated evidence search in 2016 and 2018
  - During those reviews, not sufficient evidence to review coverage policy decision
- Chosen for re-review in 2022/2023 due to new evidence that could prompt coverage policy changes
  - Evidence for expanding use for other cancer types

Washington State Health Care Authority

Key Questions

- What is the evidence of effectiveness for SBRT for patients with cancers not currently covered (CNS cancers and inoperable stage 1 NSCLC)?
- What are the harms of SBRT in patients with included cancers?
- What is the evidence that SBRT has differential efficacy or harms in subpopulations, including those defined by:
  - Sex, age, site and type of cancer, stage and grade of cancer
  - Setting, provider characteristics, equipment, quality assurance standards, procedures
- What is the evidence of cost and cost-effectiveness of SBRT?

Washington State Health Care Authority

Agency Experience Data

Washington State – Combined Medicaid & PEBB/SEBB UMP					
	2018	2019	2020	2021	**Total (unique)**
Individuals with at least one SBRT-related procedure/service	182	234	217	225	**787**
Female, count	92	116	114	135	**421**
Male, count	88	115	103	88	**359**
Number of encounters with SBRT	975	1,343	1,174	1,206	**4,698**
Amount paid, SBRT	$800,066	$1,223,446	$1,196,542	$908,197	**$4,128,250**
Amount paid, SBRT and related procedures	$1,164,151	$1,682,401	$1,657,914	$1,375,493	**$5,879,959**

Data notes: Small numbers suppressed from L&I to protect patient privacy. Claimant sex was not always reported. Annual members for Medicaid excludes members that are dually eligible for Medicaid and Medicare. Related procedures for amount paid reflects all claims submitted with the procedure code for the same date of service, and includes professional, facility, and ancillary claims (such as durable medical equipment). Managed care amount paid reflects an estimate of the amount paid for the procedure. UMP data does not reflect patient cost share. Individuals who had a procedure in more than one year are only counted once in the "Total" summary. Amounts paid of $0 were excluded from amount paid table value calculations.

Cost by CPT code

Code	Description	Medicaid FFS		L&I	
CPT		Non-facility	Facility	Non-facility	Facility
77373	Stereotactic body radiation therapy, treatment delivery, per fraction to 1 or more lesions, including image guidance, entire course not to exceed 5 fractions	$692.98	$692.98	$2,102.93	$2,102.93
77435	Stereotactic body radiation therapy, treatment management, per treatment course, to 1 or more lesions, w/ image guidance, max 5 fractions	$367.87	$367.87	$1,082.15	$1,082.15

Data notes: Medicaid FFS from October 1, 2021 Physician-Related Services Fee Schedule (accessed January 18, 2023; webpage). L&I from 2021 provider fee schedule (accessed January 18, 2023). PEBB/UMP fees are confidential and not publicly available (proprietary).

Evidence Considerations

- For each type of cancer, different bodies of evidence
- Limited number of RCTs→ Lower certainty of evidence
  - 12 RCTs in total (in 21 publications) across all cancer types
- Comparison groups
  - Differ by study and cancer type
  - Examples: convention radiation, medication only
- How outcomes are measured
  - Survival – disease free, progression free
  - Disease control
  - Quality of life

Safety

Precision and accuracy needed due to high radiation dose per fraction

- Location of Treatment
  - High doses delivered to target area
  - Margin in millimeters
  - Adjacent organs at risk (OARs)
- Equipment
- Staffing
  - Radiation oncologist and medical physicist
  - Specialized training is encouraged

Source: ACR–ASTRO PRACTICE PARAMETER FOR THE PERFORMANCE OF STEREOTACTIC BODY RADIATION THERAPY https://www.acr.org/-/media/ACR/Files/Practice-Parameters/sbrt-ro.pdf

Toxicity

- SBRT not associated with significantly higher rates of toxicity compared with other treatment modalities
- Type of toxicity varies by treatment site
- Severe and/or life-threatening toxicities were rare

Cost

- Limited studies on cost. Specific to cancer type and comparison group (cRT, medication, etc)
- Specific examples include:
  - Cost savings for low and intermediate risk prostate cancer, along with improved access to radiation treatments

Washington State Health Care Authority

Payer Coverage

Condition	United	Aetna	Cigna
Prostate	✓	✓	✓
Lung	✓	✓	✓
Pancreatic adenocarcinoma	✓	✓	✓
Liver/HCC	✓	✓	✓
Oligometastatic	✓	✓	✓
Kidney	Oligometastatic disease only	X	X
Adrenal	X	X	X
Head and Neck	X	Recurrent	Recurrent
Bone	X	Mets to spine only	X

Notes: ✓ = covered, X = not covered

Professional Society and other Guidelines

- American Society for Therapeutic Radiation Oncology (ASTRO)
- National Comprehensive Cancer Network (NCCN)
- American Society of Clinical Oncology (ASCO)
- Society for Interventional Radiology (SIR)
- European Society for Medical Oncology (ESMO)
- National Institute for Health and Care Excellence (NICE)

Notes: See pages 117 – 130 of SBRT final report for complete guideline information

Washington State Health Care Authority

Professional Society Guidelines (1)

Condition	ASTRO	NCCN	Other
Prostate	Recommended for Low- or intermediate-risk	• Acceptable efficacy and toxicity for low, intermediate, high, very high-risk groups	• AUA: strong recommendation, evidence level: Grade A • Other organizations have less strong guidance
Lung, NSCLC	Recommended for early stage inoperable NSCLC with evaluation by multidisciplinary team	Medically inoperable early-stage NSCLC • Improved local control and overall survival compared to cRT • "Reasonable alternative" to operable but high risk	• ASCO: Stage I or IIA (node negative), and in operable or patient deemed high risk • SIR: Stage IA • ESMO: Stage IV with limited synchronous metastases • NICE: Stage I-IIA who decline surgery. Stage IIIA who decline or can't tolerate chemo
Pancreatic adenocarcinoma	• Resectable, only recommended on clinical trial or multi-institutional registry • Borderline resectable and select locally advanced appropriate for downsizing, conditionally recommended • Locally advanced, not appropriate for downsizing, conditional recommendation	• Option for first line therapy for locally advanced disease, good performance status • Not candidates for induction chemo • Treatment for recurrence	• ASTRO caveats: adjuvant SBRT post operatively recommended in clinical trial setting

Notes: See pages 117 – 130 of SBRT final report for complete guideline information

Washington State Health Care Authority

Professional Society Guidelines continued (2)

Condition	ASTRO	NCCN	Other
Liver/HCC	• Candidates for OLT, conditionally recommended as a bridge to transplant or downstaging • Liver confined HCC, recommended	• Alternative to ablation/embolization when these therapies have failed/contraindicated • Unresectable or inoperable	• ACR: Hepatocellular cancer with solitary tumor 0–3cm "may be appropriate" • ESMO: may be considered as alternative for ablation of tumors with high risk of local failure
Oligometastatic		Based on cancer type	
Kidney		May be considered for medically inoperable stage I or stage II	• ESMO: Option for management in metastatic disease • Limited other guidance
Adrenal		Can consider	
Head and neck		Insufficient evidence to recommend	
Bone		Consider for oligometasteses	• ESMO: Patients unfit for surgery

Notes: See pages 117 – 130 of SBRT final report for complete guideline information

Washington State Health Care Authority

Cost-effectiveness

Condition	Cost-effectiveness Considerations	Certainty
Prostate	May be lower in cost than IMRT May be cost effective for oligometastatic hormone resistant cancer	N/A
Lung	May be cost ineffective for maintenance therapy for oligometastatic disease	N/A
Pancreatic adenocarcinoma	May be higher cost than cRT or chemo – very lower certainty of evidence	Very low
Liver/HCC	May be cost ineffective compared to RFA, however is cost effective for salvage therapy- low to moderate certainty of evidence	Low to moderate
Oligometastatic	May be cost-effective, moderate certainty of evidence based on 2 modeling studies	Moderate
Kidney	N/A	N/A
Adrenal	N/A	N/A
Bone	N/A	N/A

Agency Medical Director Group
Recommendation

Localized Prostate cancer: covered with conditions

SBRT is a covered benefit for:

- Very low, low and intermediate risk prostate cancer, as defined by NCCN based on stage, Gleason score and PSA level
- Evaluation includes multidisciplinary team analysis with surgical input

Agency Medical Director Group
Recommendation

Non Small Cell Lung Cancer (NSCLC): covered with conditions

- SBRT is a covered benefit for :
  - non small cell lung cancer
    - Stage I and Stage IIA (node negative)

    AND
  - Medically inoperable, or patient is deemed too high risk, or declines operative intervention
- Evaluation includes multidisciplinary team analysis with surgical input

Agency Medical Director Group
Recommendation

Pancreatic Adenocarcinoma: covered with conditions

- SBRT is a covered benefit for:
  - Locally advanced pancreatic adenocarcinoma,
- Non covered for those with evidence of direct invasion of bowel or stomach based on CT, MRI or endoscopy
- Evaluation includes multidisciplinary team analysis with surgical input

Agency Medical Director Group
Recommendation

Oligometastatic disease: covered with conditions

- SBRT is a covered benefit for:
  - Oligometastatic disease as defined by:
    - Three or fewer metastatic lesions in synchronous setting
    - Appropriate imaging demonstrating no evidence of widespread metastatic disease
    - Karnofsky performance score greater than or equal to 60, or ECOG score less than or equal to 2
  - Evaluation includes multidisciplinary team analysis with surgical input

Agency Medical Director Group
Recommendation

Hepatocellular carcinoma: covered with conditions

- SBRT is a covered benefit for:
  - Hepatocellular carcinoma
    - 5 or fewer lesions, 6cm or smaller

    AND
    - Karnofsky performance score greater than or equal to 60, or ECOG score less than or equal to 2

    OR
    - Unresectable/inoperable disease, not a candidate for liver transplant
  - Evaluation includes multidisciplinary team analysis with surgical input

Agency Medical Director Group

Recommendations

SBRT is not a covered benefit for treatment of the *primary* tumor of the following cancer types:

- Renal
- Adrenal
- Bone
- Small cell lung cancer
- Melanoma
- Merkel Cell
- Biliary tract cancer
- Head and neck cancers
- Breast *
- Ovarian*
- Cervical *
- Esophageal *
- Colorectal *

SBRT is a covered benefit for treatment of oligometastatic lesions.

* Not included in final evidence report due to lack of new eligible studies

SUMMARY OF AMD COVERAGE RECOMMENDATIONS

Condition(s)	Recommendations
Prostate	SBRT is a covered benefit for very low, low and intermediate risk prostate cancer as defined by NCCN based on stage, Gleason score and PSA Level
Lung	SBRT is a covered benefit for non small cell lung cancer Stage I and Stage IIA, tumors considered medically inoperable, or patient is deemed too high risk, or declines operative intervention.
Pancreatic adenocarcinoma	SBRT is a covered benefit for locally advanced pancreatic adenocarcinoma. Non-covered for those with evidence of direct invasion of bowel or stomach based on CT, MRI or endoscopy
Liver/HCC	SBRT is a covered benefit for hepatocellular carcinoma in the following settings: 5 or fewer lesions, 6cm or smaller, and Karnofsky performance score greater than or equal to 60, or ECOG score less than or equal to 2 OR for unresectable/inoperable disease, not a candidate for liver transplant
Oligometastatic	SBRT is a covered benefit for oligometastatic disease as defined by three or fewer lesions in a synchronous setting, with appropriate imaging demonstrating no evidence of widespread metastatic disease. KS greater than or equal to 60, ECOG less than or equal to 2.
Renal, Adrenal, Bone, SCLC, Melanoma, Merkel Cell, Biliary tract cancer, head and neck cancer, breast, ovarian , cervical, esophageal, colorectal	SBRT is not a covered benefit.

Washington State Health Care Authority

Questions?

More Information:

Sophie Cain Miller, MD, MPH
Sophie.miller@hca.wa.gov

Cancer Type	Prostate cancer, localized
Evidence	• 2023 upate-4 RCTs, 14 comparative studies, 18 noncomparative studies • RCTs w adequate sample size • Similarly or more effective than other options • Low to moderate certainty of evidence
Other payors	United, Aetna, Cigna
ASTRO	Recommended, low or intermediate risk
NCCN	"acceptable efficacy and toxicity" for low, intermediate, high, very high risk groups
Cost	May be lower in cost than IMRT May be cost effective for oligometastatic hormone resistant cancer
Other considerations	Toxicity- some evidence for increased urinary obstruction/retention

Cancer Type	Non Small Cell Lung Cancer
Evidence	2023 update:- 1 RCT, 11 comparative studies, 11 non comparative studies • Similarly or more effective than cRT • Low to moderate certainty of evidence
Other payors	United, Aetna, Cigna
ASTRO	Early stage medically inoperable
NCCN	Medically inoperable early stage NSCLC • Improved local control and overall survival compared to cRT • "Reasonable alternative" to operable but high risk
Cost	May be cost ineffective for maintenance therapy for oligometastatic disease
Other considerations	For pts at high surgical risk recommend multidisciplinary evaluation

Cancer Type	Liver cancer/HCC
Evidence	• 2023 update- 20 comparative studies • May be as effective as radiofrequency ablation for early-stage liver cancer- results mixed • Alone or in combo with other treatments for small liver cancers • May be more effective than sorafenib for advanced liver cancer • Low to very lower certainty of evidence
Other payors	United, Aetna, Cigna
ASTRO	Recommended for coverage
NCCN	Alternative to ablation/embolization when these therapies have failed/contraindicated Unresectable or inoperable
Cost	May be cost ineffective compared to RFA, however is cost effective for salvage therapy- low to moderate certainty of evidence
Other considerations	

Cancer Type	Oligometastatic
Evidence	• 2023 update- 3 RCTs, 3 comparative studies, 12 non comparative studies • More effective than standard of care or observation • Low to moderate certainty of evidence • (except for prostate Ca)
Other payors	United, Aetna, Cigna
ASTRO	Recommended for coverage
NCCN	Based on cancer type
Cost	May be cost-effective, moderate certainty of evidence based on 2 modeling studies
Other considerations	Detailed criteria for defined patient population

Cancer Type	Pancreatic adenocarcinoma
Evidence	• 2023 update–3 comparative studies • May be more effective than cRT • Low certainty of evidence
Other payors	United, Aetna, Cigna
ASTRO	Conditionally recommended for borderline resectable, locally advanced
NCCN	• Option in list of first line therapy–following chemo or in patients not candidates for chemo • Treatment for recurrence • Good performance status
Cost	May be higher cost than cRT or chemo – very lower certainty of evidence
Other considerations	SBRT should be delivered at an "experienced, high-volume center" per NCCN

Cancer Type	Kidney cancer
Evidence	• 2012- no eligible studies • 2023 update: 1 comparative study, N=90,000 • For stage I RCC, SBRT associated with worse overall survival compared to ablation or surgery, low certainty of evidence
Other payors	United for oligometastatic disease only
ASTRO	
NCCN	May be considered for medically inoperable stage I or stage II
Other considerations	

Cancer Type	Adrenal
Evidence	• 2023 update: 1 noncomparative study, harms only. High risk of bias due to lack of comparator
Other payors	Not covered
ASTRO	
NCCN	“can consider”
Other considerations	

Cancer Type	Head and Neck Cancers
Evidence	• 2023 update: 1 RCT , 4 comparative studies • May be similarly effective to brachytherapy • May be less effective than charged particle RT • Similar in effectiveness to IMRT
Other payors	Aetna, Cigna (previously irradiated sites)
ASTRO	
NCCN	*"currently insufficient evidence to recommend SBRT for treatment of H&N cancers"*
Other considerations	

Cancer Type	Bone
Evidence	In 2012 review, no eligible studies. 2023 review, single center RCT, N=160
Other payors	Cigna (mets to spine only)
ASTRO	
NCCN	
Other considerations	Spinal lesions already covered by 2012 HTCC decision

Stereotactic Radiosurgery and Stereotactic Body Radiation Therapy: Final Evidence Report

Washington Health Technology Clinical Committee Meeting

May 19, 2023

Presented by Beth Shaw, MSc, and Valerie King, MD, MPH

EVIDENCE-BASED POLICY CENTER FOR

Technology

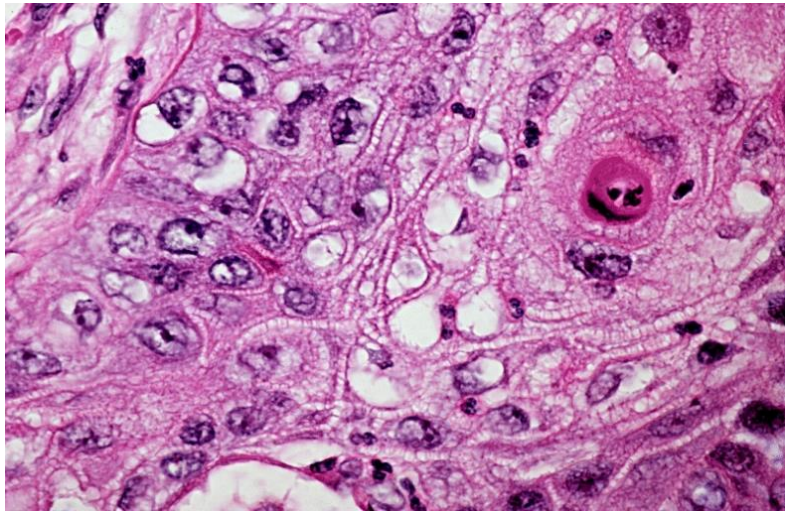
- Radiation therapy (RT) uses high-energy X-ray or other particles to destroy cancer cells
  - Usually consists of a specific number of treatments over a set time period
  - Can be used in combination with other treatments, such as chemotherapy or surgery
- Most common type of RT is external-beam RT (EBRT)
  - 3-dimensional conformal radiation therapy (3D-CRT)
  - Intensity modulated radiation therapy (IMRT)
  - Proton beam therapy (PBT)
  - Image-guided radiation therapy (IGRT)
  - Stereotactic body radiation therapy (SBRT)

Technology

- Stereotactic body radiation therapy (SBRT) or stereotactic ablative radiotherapy (SABR)
  - Typically delivered in 1 to 5 fractions
  - Can be primary treatment for early-stage cancers, treatment for discrete tumors in oligometastatic disease, for selected benign neoplasms in or near the central nervous system (CNS), or in recurrent cancer within previously irradiated regions
- Other radiation-based options include implanted internal radiation therapy (or brachytherapy), intraoperative radiation therapy (IORT), systemic radiation therapy, radioimmunotherapy, and radiosensitizers or radioprotectors

Clinical Need

- In 2019, 1,752,735 new invasive cancer cases were reported in the US
  - 863,830 in females and 888,905 in males
  - Incidence rate was 439 per 100,000
- While cancer affects people of all ages, races, ethnicities, and sexes, it does not affect all groups equally
  - Genetics, lifestyle, environmental exposures, and other factors can lead to differences in risk
  - For most cancers, age is the most important risk factor, with around 58% of cancers occurring in adults aged 65 years or older

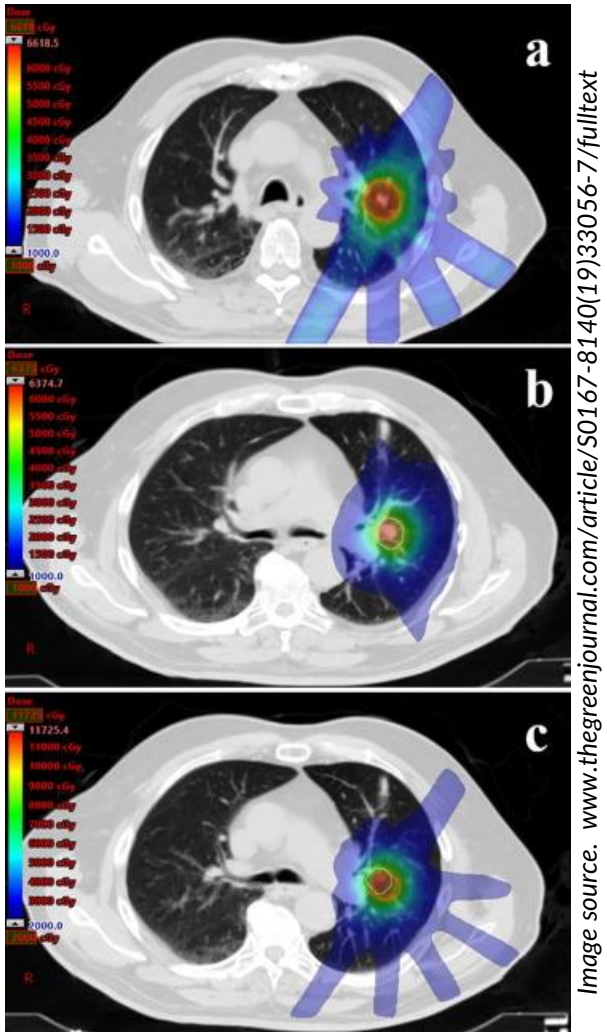


History

- In 2012, HTA on the effectiveness of stereotactic radiation surgery (SRS) and SBRT for treating various cancers was commissioned
- In 2013, coverage determination adopted
  - SRS for CNS primary and metastatic tumors is a covered benefit for adults and children when the following criteria are met:
    - Patient functional status score (i.e., Karnofsky score) is greater than or equal to 50; **and**
    - Evaluation includes multidisciplinary team analysis (e.g., tumor board), including surgical input
  - SBRT is covered for adults and children for the following conditions when the following criteria are met:
    - For cancers of spine/paraspinal structures; **or**
    - For inoperable non-small cell lung cancer (NSCLC), stage 1; **and**
    - Evaluation includes multidisciplinary team analysis, including surgical input
  - All other indications are noncovered

History

- Since 2012, 3 signal search reports were conducted
- In 2022, SBRT was selected for rereview based on newly available published evidence that could change the original coverage decision
- Aim of the 2023 update
  - Conduct updated evidence searches
  - Produce an updated evidence review



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Abbreviations

- **ADT** androgen deprivation therapy
- **aHR** adjusted hazard ratio
- **CI** confidence interval
- **cRT** conventional radiation therapy
- **CT** chemotherapy
- **EBRT** external beam radiation therapy
- **ENRT** elective nodal radiation therapy
- **FDA** U.S. Food and Drug Administration
- **GI** gastrointestinal
- **GRADE** Grading of Recommendations, Assessment, Development, and Evaluation
- **GU** genitourinary
- **Gy** Gray
- **HFRT** hypofractionated radiotherapy
- **HIFU** high-intensity focused ultrasound
- **HR** hazard ratio
- **ICER** incremental cost-effectiveness ratio
- **IMRT** intensity-modulated RT
- **IV** intravenous
- **KQ** key question

Abbreviations

- **LCNEC** large-cell neuroendocrine carcinoma of the lung
- **MFRT** multifraction radiation therapy
- **NCT** US National Clinical Trial
- **NSCLC** non-small cell lung cancer
- **NR** not reported
- **NRS** nonrandomized study
- **OR** odds ratio
- **PFS** progression-free survival
- **QALY** quality-adjusted life year
- **RCT** randomized controlled trial
- **RFA** radiofrequency ablation
- **RT** radiation therapy
- **SABR** stereotactic ablative radiotherapy
- **SBRT** stereotactic body radiation therapy
- **TA** thermal ablation
- **TACE** transarterial chemoembolization
- **UHRT** ultrahypofractionated radiation therapy

Key Questions

- Effectiveness in cancers not currently covered
- Harms in cancers not currently covered
- Differential efficacy or harms
  - Patient characteristics
  - Cancer type, site, grade, stage
  - Setting or provider characteristic
- Costs and cost-effectiveness

Methods

- Rescreened studies identified from the previous report and signal searches against criteria for this update
- Checked studies submitted during public comment on the PICOS and key questions
- Ran database searches in OVID Medline and Cochrane
- Searched websites and databases for clinical guidelines
- Searched FDA databases and ClinicalTrials.gov for harms and ongoing studies
- Assessed risk-of-bias (RoB) using standardized checklists
- Assessed certainty of evidence (CoE) using GRADE approach

Risk-of-Bias Assessment

- **Low**

  Clear reporting of methods and mitigation of potential biases

- **Moderate**

  Incomplete information about methods that might mask important limitations

- **High**

  Clear flaws that might introduce serious bias

GRADE Certainty of Evidence

Outcomes rated: overall survival, progression, disease control, quality of life, and toxicity

- **High** *(RCTs start here)*

  Very confident the estimate of effect of intervention on outcome lies close to the true effect

- **Moderate**

  Moderately confident in estimate of effect of intervention on outcome; true effect is likely close to estimate, but possibly different

- **Low** *(Nonrandomized studies start here)*

  Little confidence in estimate of effect of intervention on outcome; true effect may be substantially different from estimate

- **Very Low**

  No confidence in estimate of effect of intervention on outcome; true effect is likely substantially different from estimate

Outcomes

Outcome Measure	Advantages	Disadvantages
Overall survival (OS)	• Easily and precisely measured • Generally based on objective and quantitative assessment	• May be affected by switch-over of control to treatment or subsequent therapies • Needs longer follow-up • Includes noncancer deaths
Disease-free survival, event-free survival	• Generally assessed earlier and with smaller sample size than survival studies • Generally based on objective and quantitative assessment	• Potentially subject to assessment bias, particularly in open-label studies • Definitions vary among studies • Balanced timing of assessments among treatment arms is critical • Includes noncancer deaths

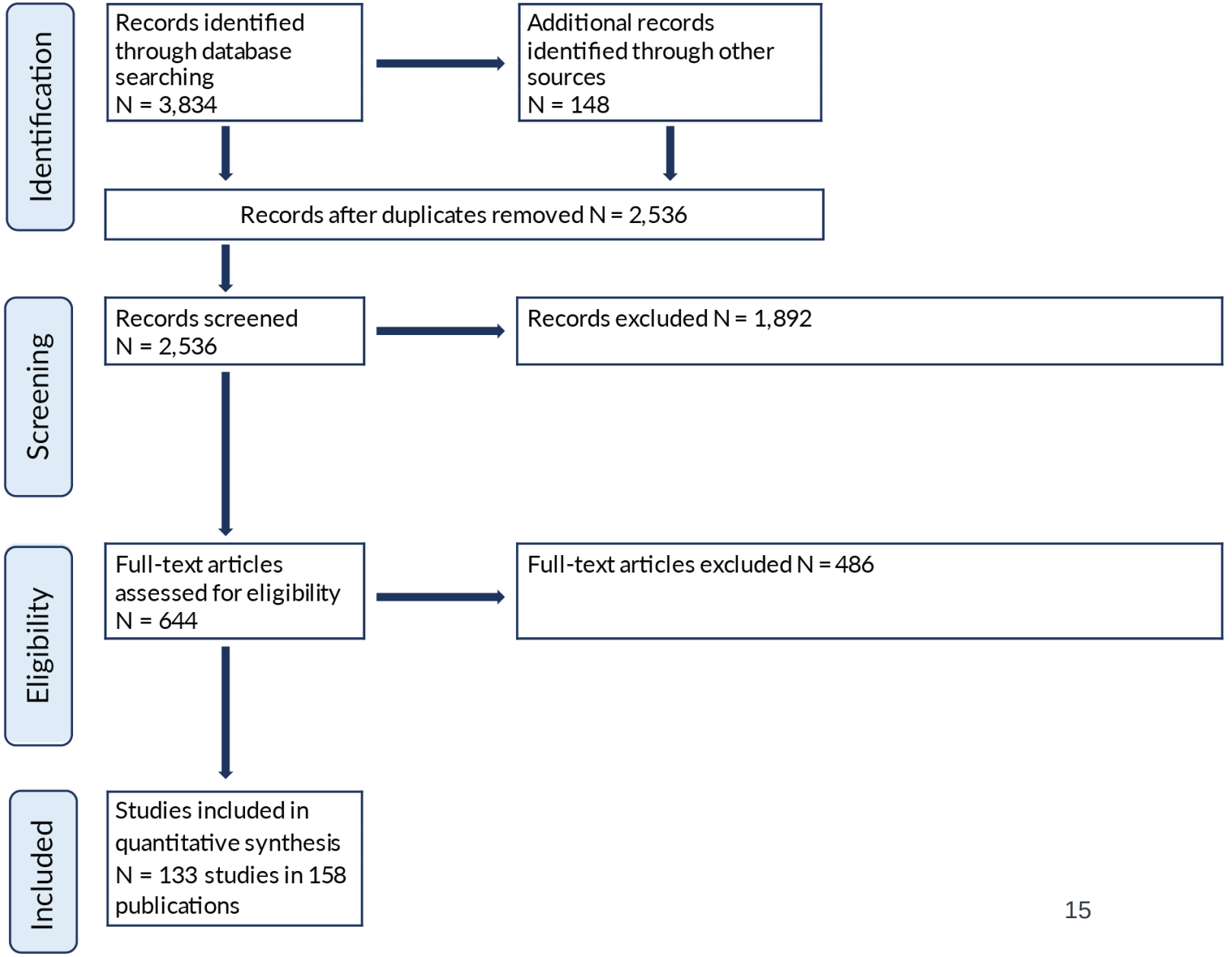
Outcomes (cont.)

Outcome Measure	Advantages	Disadvantages
Progression-free survival (PFS), time to progression	• Generally assessed earlier and with smaller sample size than survival studies • Measurement of stable disease included • Generally based on objective and quantitative assessment	• Potentially subject to assessment bias, particularly in open-label studies • Definitions vary among studies • Frequent radiological or other assessments • Balanced timing of assessments among treatment arms is critical • May not always correlate with survival
Objective response rate (ORR)	• Generally assessed earlier and with smaller sample size than survival studies • Effect on tumor attributable to drug(s) or other treatment, not natural history • Generally based on objective and quantitative assessment	• Definitions vary among studies • Frequent radiological or other assessments • May not always correlate with survival
Complete response rate (CRR)		

Findings

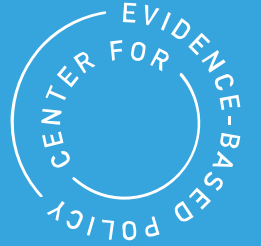
Updated Evidence Review

Study Flow


Identification
Records identified through database searching N = 3,834
Additional records identified through other sources N = 148
Records after duplicates removed N = 2,536
Screening
Records screened N = 2,536
Records excluded N = 1,892
Eligibility
Full-text articles assessed for eligibility N = 644
Full-text articles excluded N = 486
Included
Studies included in quantitative synthesis N = 133 studies in 158 publications

Findings

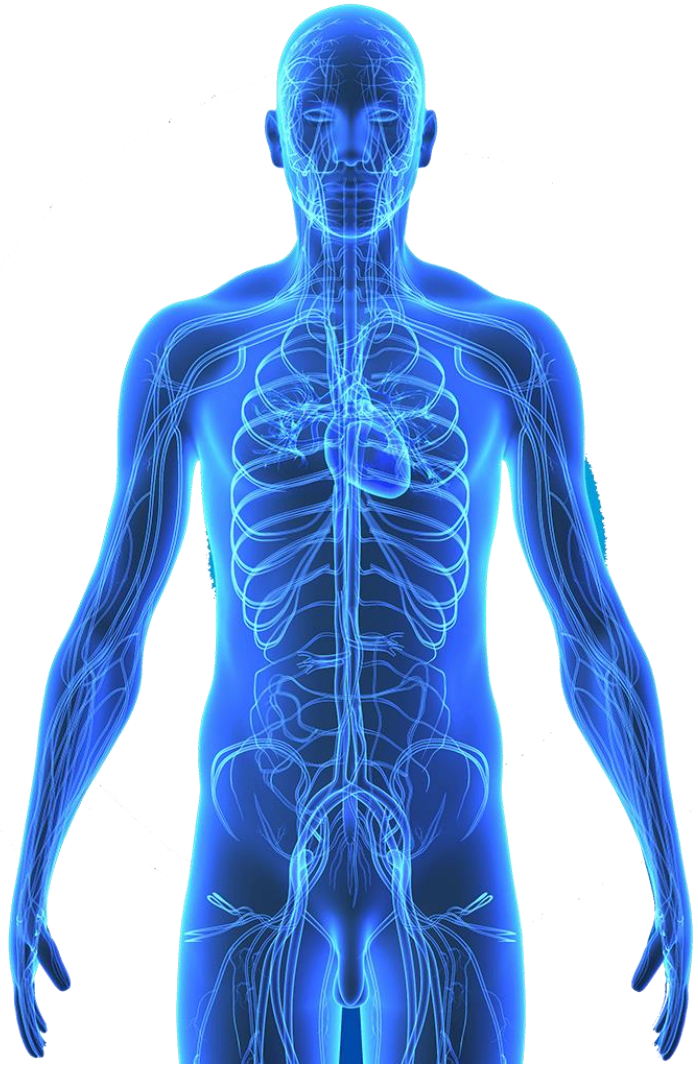
Key Questions 1 to 3: Effectiveness



Findings by Cancer Site

- **Breast**
- Prostate
- Lung
- **Colorectal**
- **Uterine**
- Melanoma
- Renal
- Pancreatic
- Head and neck
- **Ovarian**
- Liver
- **Cervical**
- **Esophageal**
- Oligometastatic
- Other

Note: Bold indicates cancer sites for which we did not identify any eligible studies for this update.



Prostate Cancer

- 2012 report
  - In the 2012 report, overall strength of evidence was assessed as very low for harms based on 4 case series
  - No comparative studies on the effectiveness of SBRT
- 2023 update
  - 4 RCTs
  - 14 comparative nonrandomized studies (NRSs)
  - *18 noncomparative studies (harms only)*

Prostate Cancer

Citation Setting NCT or Other Trial ID or Study Name	Duration Risk-of-bias	Patient Characteristics	Intervention	Comparator(s)
Randomized controlled trials				
Brand et al, 2019 37 centers in the UK, Ireland, and Canada **NCT01584258** **PACE-B**	Followed up to 24 months Moderate risk-of-bias	Total N = 874 men with low- to intermediate-risk localized prostate cancer, comprising 433 in the SBRT group and 441 in the control group	• SBRT ◦ 36.25 Gy in 5 fractions over 1 to 2 weeks (i.e., daily or alternate days, at center discretion), with an additional secondary CTV dose target of 40 Gy	• cRT or moderately hypofractionated radiotherapy ◦ PTV dose was 78 Gy in 39 daily fractions or, following an approved protocol amendment, 62 Gy in 20 daily fractions
Kwan et al., 2022 2 sites in Canada **NCT02594072** **ASSERT**	At least 6 months Moderate risk-of-bias	Total N = 80 men with intermediate- to high-risk localized prostate cancer, comprising 42 in the SBRT group and 36 in the control group	• SBRT ◦ 36.25 Gy in 5 fractions weekly ◦ ADT (6 months in intermediate risk and 18 months in high-risk) by either luteinizing hormone-releasing hormone agonists or antagonists	• Moderate hypofractionation RT ◦ 70 Gy in 28 fractions 5 times a week ◦ ADT (6 months in intermediate risk and 18 months in high-risk) by either luteinizing hormone-releasing hormone agonists or antagonists

Prostate Cancer

Citation Setting NCT or Other Trial ID or Study Name	Duration Risk-of-bias	Patient Characteristics	Intervention	Comparator(s)
Randomized controlled trials				
Lukka et al., 2018 37 sites, including academic centers, in the US and Canada **NCT01434290**	Median follow-up of 3.8 years Moderate risk-of-bias	Total N = 255 men with localized T1 to T2 stage prostate cancer, comprising 127 in the SBRT in the group and 128 in the UHRT group	• SBRT ◦ 36.25 Gy in 5 fractions of 7.25 Gy ◦ More than 2 weeks	• UHRT ◦ 51.6 Gy in 12 fractions of 4.3 Gy ◦ More than 2.5 weeks
Widmark et al., 2019 12 centers in Sweden and Denmark **ISRCTN45905321** **HYPO-RT-PC**	Followed up to 10 years Moderate risk-of-bias	Total N = 1,200 men with intermediate-to-high-risk localized prostate cancer, comprising 598 in the SBRT group and 602 in the cRT group	• SBRT ◦ 42.7 Gy in 7 fractions ◦ 3 days over 2.4 weeks	• cRT ◦ 78.0 Gy in 39 fractions ◦ 5 days per week for 8 weeks

Prostate Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. cRT for intermediate-to-high-risk localized prostate cancer			
Overall survival			
N = 1,200 1 RCT	In intermediate-to-high-risk localized prostate cancer: • 5-year overall survival: HR, 1.11; 95% CI, 0.73 to 1.69	⨁⨁◯◯ LOW	Downgraded 2 levels for imprecision (i.e., very wide CIs)
Progression-free survival			
N = 1,200 1 RCT	In intermediate-to-high-risk localized prostate cancer: • 5-year failure-free survival (biochemical or clinical failure: aHR, 1.00 (95% CI, 0.76 to 1.33)	⨁⨁⨁◯ MODERATE	Downgraded 1 level for imprecision (i.e., wide CIs)
Disease-control			
N = 1,200 1 RCT	In intermediate-to-high-risk localized prostate cancer: • Local failure: HR, 0.94; 95% CI, 0.40 to 2.22 • Distant failure: HR, 0.99; 95% CI, 0.63 to 1.54 • Use of ADT at 5 years: HR, 1.12; 95% CI, 0.79 to 1.59	⨁◯◯◯ VERY LOW	Downgraded 1 level for risk of bias and 2 levels for imprecision (i.e., very wide CIs)

Prostate Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. other forms of RT for localized prostate cancer (all risk groups)			
Overall survival			
N = 75,749 5 comparative NRSs	Men with localized prostate cancer (all risk groups) treated with SBRT had similar or improved overall survival when compared with other treatment options, including cRT, IMRT and brachytherapy; studies reported at different times using different statistics, precluding any summary statistics (see detailed findings below).	⨁⨁◯◯ LOW	Not downgraded
Disease-control			
N = 1,190 4 comparative NRSs	Men with localized prostate cancer (all risk groups) treated with SBRT had similar or improved disease control when compared with other treatment options, including cRT, IMRT and brachytherapy, with biochemical control rates of around 89% to 100% at 5 years.	⨁⨁◯◯ LOW	Not downgraded

Prostate Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. other forms of RT for localized prostate cancer (all risk groups)			
Quality of life			
N = 2,154 3 RCTs	Men with localized prostate cancer (all risk groups) treated with SBRT had a similar quality of life to men treated with other forms of RT; however, specific symptoms affecting quality of life may vary between treatments.	⨁⨁◯◯ LOW	Downgraded 1 level each for risk-of-bias and imprecision (i.e., not assessable)

Prostate Cancer

- Based on the studies included in this review, we conclude that SBRT:
  - May be similarly or more effective than other options for individuals with localized prostate cancer (**very low** to **moderate** certainty of evidence [CoE], based on 4 RCTs and 14 comparative NRSs)

Prostate Cancer

- Eligible guidelines made primarily conditional recommendations on the use of SBRT as an option for treating prostate cancer
  - 2022 American Society for Radiation Oncology and American Urological Association (ASTRO/AUA)
    - Strong recommendations on the use of SBRT for low- or intermediate-risk localized prostate cancer
    - Wording suggests a conditional approach with SBRT being offered as an option
  - 2022 Prostate Cancer Guidelines Panel (European Joint guidelines)
    - SBRT solely as a subject for future investigation
  - 2018 Australian and New Zealand Faculty of Radiation Oncology Genito-Urinary Group (FROGG)
    - SBRT an option for metastatic disease or as salvage therapy with inconsistent, low-quality evidence
    - Highlights the need for more clinical trials

Lung Cancer

- In 2013, the following coverage determination was adopted:
  - SBRT is covered for adults and children for the following conditions when these criteria are met:
    - For inoperable NSCLC, stage 1; and
    - Evaluation includes multidisciplinary team analysis, including surgical input
- 2012 report
  - Included 20 noncomparative NRSs in lung cancer, other than in inoperable NSCLC, stage 1 lung cancer
  - Populations in the studies tended to be mixed, and included both primary lung cancer and metastatic lung cancer
  - No coverage determination for other forms of lung cancer

Lung Cancer

- 2023 update
  - 2 RCTs
  - 11 comparative NRSs
  - *11 noncomparative studies (harms only)*

Lung Cancer

Citation Setting NCT or Other Trial ID or Study Name	Duration Risk-of-bias	Patient Characteristics	Intervention	Comparator(s)
Randomized controlled trials				
Altorki et al., 2021 Single center in the US **NCT02904954**	Followed up to 2 years Moderate risk-of-bias	Total N = 60 people with potentially resectable early-stage NSCLC (stages IA to IIIA), comprising 30 in durvalumab plus SBRT group and 30 in durvalumab group	• SBRT plus durvalumab ◦ 3 consecutive daily fractions of 8 Gy ◦ 2 cycles of durvalumab 3 weeks apart at a dose of 1·12 g by IV infusion over 60 min	• Durvalumab ◦ 2 cycles of durvalumab 3 weeks apart at a dose of 1·12 g by IV infusion over 60 min
Theelen et al., 2019 3 centers in the Netherlands **NCT02492568** **PEMBRO-RT**	Median follow-up of 24 months Moderate risk-of-bias	Total N = 78 people with advanced NSCLC, comprising 38 in SBRT group and 40 in control group	• SBRT plus pembrolizumab ◦ 3 doses of 8 Gy delivered on alternate days to a single tumor site that did not overlap with biopsy site and was deemed most safe or convenient for patient ◦ Pembrolizumab administered IV at 200 mg every 3 weeks	• Pembrolizumab ◦ Pembrolizumab administered IV at 200 mg every 3 weeks

Lung Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. surgery or no SBRT for operable early-stage NCSLC			
Overall survival			
N = 41,583 3 comparative NRSs	SBRT was associated with significantly worse outcomes than surgery for operable early-stage NCSLC; surgery was associated with around a 60 to 65% lower risk of mortality. However, 1 study did find that in patients who were medically operable, SBRT and lobectomy may be equally effective.	⨁◯◯◯ VERY LOW	Downgraded 1 level for inconsistency
Progression-free survival			
N = 187 1 comparative NRS	In patients who were medically operable, SBRT and lobectomy may be equally effective (HR, 1.57; 95% CI, 0.68 to 3.64)	⨁◯◯◯ VERY LOW	Downgraded 1 level for risk-of-bias and 2 levels for imprecision (i.e., very wide CIs)
Disease-control			
N = 60 1 RCT	In people with potentially resectable early-stage NCSLC, SBRT in combination with durvalumab was associated with significantly higher odds of having a major pathological response (OR, 16.0; 95% CI, 3.2 to 79.6) or a partial radiographic response (46.7% SBRT with durvalumab vs. 3.3% durvalumab; *P* = .001) than durvalumab alone.	⨁⨁⨁◯ MODERATE	Downgraded 1 level for risk-of-bias

Lung Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. RT for inoperable stage II			
Overall survival			
N = 4,401 1 comparative NRS	SBRT appears to be associated with improved survival than cRT (HR, 0.79; 95% CI, 0.71 to 0.87) or hypofractionated radiotherapy (HR, 0.57; 95% CI, 0.50 to 0.66) for inoperable stage II NSCLC.	⨁⨁◯◯ LOW	Not downgraded

Lung Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. no SBRT for advanced NCSLC			
Overall survival			
N = 78 1 RCT	People with advanced NSCLC treated with SBRT after pembrolizumab or pembrolizumab alone had a similar overall survival (median: 15.9 months SBRT vs. 7.6 months control; HR, 0.66; 95% CI, 0.37 to 1.18) However, in subgroup analyses, men (HR, 0.42; 95%CI, 0.19 to 0.96; *P* = .04) and smokers (HR, 0.48; 95% CI, 0.25 to 0.93; *P* = .03) had significantly improved survival with SBRT compared with pembrolizumab alone.	⨁⨁⨁◯ MODERATE	Downgraded 1 level for imprecision (i.e., wide CIs)
Progression-free survival			
N = 78 1 RCT	People with advanced NSCLC treated with SBRT after pembrolizumab or pembrolizumab alone had a similar PFS (HR, 0.71; 95% CI, 0.42 to 1.18).	⨁⨁◯◯ LOW	Downgraded 1 level each for risk-of-bias and imprecision (i.e., wide CIs)

Lung Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. surgery or cRT for lung metastases			
Overall survival			
N= 483 4 comparative NRSs	In people with lung metastases, SBRT and surgery may be associated with similar overall survival (median survival at 2 years of around 68% to 77% in the SBRT group vs. 82% in the surgery group); however, SBRT may be associated with improved survival when compared with cRT (median survival of 26 months in the SBRT group vs. 9 months in the cRT group; *P* < .001).	⨁⨁◯◯ LOW	Not downgraded
Progression-free survival			
N = 301 3 comparative NRSs	People with lung metastases treated with SBRT had significantly worse PFS than people treated with surgery (around 3 times more likely to have progression). However, results were mixed with 1 study showing no difference between SBRT and surgery.	⨁◯◯◯ VERY LOW	Downgraded 1 level for inconsistency
Disease-control			
N = 694 4 comparative NRSs	Results were mixed with SBRT being associated with both similar and lower levels of local control than surgery for lung metastases. SBRT, however, was significantly associated with improved local control when compared with cRT. Studies reported at different times using different statistics, precluding any summary statistics (see detailed findings below).	⨁◯◯◯ VERY LOW	Downgraded 1 level for inconsistency

Lung Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. surgery or cRT for LCNEC of the lung			
Overall survival			
N = 3,963 2 comparative NRSs	In people with LCNEC of the lung, SBRT may be associated with improved survival when compared with cRT (HR, 0.83; 95% CI, 0.68 to 1.00)[b], but worse outcomes when compared with surgery (HR, 1.61; 95% CI, 1.36 to 1.92).	⨁⨁◯◯ LOW	Not downgraded

Lung Cancer

- Based on the studies included in this review, we conclude that SBRT:
  - May be similarly or more effective than radiation therapy for inoperable stage II non-small cell lung cancer (NSCLC; low CoE, based on 1 comparative NRS) or in combination with pembrolizumab compared with pembrolizumab alone for advanced NSCLC (low to moderate CoE, based on 1 RCT)
  - Also appears to be similarly or more effective than conventional radiation therapy (cRT) for people with lung metastases (very low to low CoE, based on 4 comparative NRSs) or large cell neuroendocrine carcinoma (LCNEC) of the lung (low CoE, based on 2 comparative NRSs)
  - May be less effective than surgery for resectable lung cancer (very low to low CoE, based on 10 comparative NRSs)

Lung Cancer

- Overall, the guidelines indicate there is some evidence for the use of SBRT for lung cancer
  - Evidence quality is generally moderate-to-low
  - Usually recommended for patients who refuse or who are at high risk for surgery, lobectomy, or chemotherapy
  - For patients who are operable, SBRT is still considered a therapy under investigation in the current guidelines

Melanoma

- 2012 report
  - In 2012, the overall strength of evidence was assessed as very low for harms, based on 7 case series
  - No comparative studies were identified
- 2023 update
  - 1 RCT in Merkel cell carcinoma

Melanoma

Citation Setting NCT or Other Trial ID	Duration Risk-of-bias	Patient Characteristics	Description of Intervention	Description of Comparator(s)
Kim et al., 2022 2 centers, 1 academic, in the US **NCT03071406**	Median follow-up of 15 months Moderate risk-of-bias	Total N = 50 people with advanced Merkel cell cancer, comprising 25 in SBRT group and 25 in control group	• SBRT ◦ 24 Gy in 3 fractions ◦ To at least 1 tumor site ◦ Nivolumab and ipilimumab	◦ Nivolumab and ipilimumab

Melanoma

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT with nivolumab and ipilimumab vs. nivolumab and ipilimumab for Merkel cell carcinoma			
Overall survival			
N = 50 1 RCT	No difference between groups by immunotherapy status: • Naïve to treatment: HR, 2.12; 95% CI, 0.13 to 34.23 • Previous treatment: HR, 2.15; 95% CI, 0.83 to 5.57	⊕⊕◯◯ LOW	Downgraded 2 levels for imprecision (i.e., very wide CIs)
Progression-free survival			
N = 50 1 RCT	No difference between groups by immunotherapy status: • Naïve to treatment: HR, 1.77; 95% CI, 0.11 to 28.38 • Previous treatment: HR, 1.60; 95% CI, 0.68 to 3.75	⊕⊕◯◯ LOW	Downgraded 2 levels for imprecision (i.e., very wide CIs)
Disease-control			
N = 50 1 RCT	Response: 50% vs. 72%; *P* = .26	⊕⊕◯◯ LOW	Downgraded 1 level each for risk-of-bias and for imprecision (i.e., not assessable)

Melanoma

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT with nivolumab and ipilimumab vs. nivolumab and ipilimumab for Merkel cell carcinoma			
Toxicity			
N = 50 1 RCT	8 (16%) discontinued the protocol treatment due to toxicity. No deaths were attributed to treatment. Grade 3 events occurred in 24% of SBRT group and 28% in control group; grade 4 events occurred in 8% and 12% by group.	⊕⊕◯◯ LOW	Downgraded 1 level each for risk-of-bias and for imprecision (i.e., not assessable)

Melanoma

- Based on the studies included in this review, we conclude that SBRT:
  - In combination with nivolumab and ipilimumab, may be as effective as nivolumab and ipilimumab for Merkel cell carcinoma (**low** CoE, based on 1 RCT)

Melanoma

- For melanoma, the 1 eligible guideline recommends the use of SBRT for locoregional recurrence or single distant metastases, based on low-quality evidence

Renal Cell Carcinoma

- 2012 report
  - No eligible studies identified
- 2023 update
  - 1 comparative NRS
  - *1 noncomparative study (harms only)*

Renal Cell Carcinoma

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. cRT in stage I RCC			
Overall survival			
N = 91,965 1 comparative NRS	In people with stage I RCC, SBRT was associated with a significantly worse overall survival than people treated with ablation or surgery: • Partial nephrectomy vs. SBRT: HR, 0.29 (95% CI, 0.19 to 0.46) • Cryoablation vs. SBRT: HR, 0.40 (95% CI, 0.26 to 0.60) • Radiofrequency ablation or microwave ablation vs. SBRT: HR, 0.46 (95% CI, 0.31 to 0.67)	⨁⨁◯◯ LOW	Not downgraded

Renal Cell Carcinoma

- Based on the studies included in this review, we conclude that SBRT:
  - May be less effective than ablation (RFA, microwave, or cryoablation) or surgery for stage 1 renal cell carcinoma (low CoE, based on 1 comparative NRS)

Renal Cell Carcinoma

- Overall, the guidelines make conditional recommendations on the use of SBRT for certain clinical situations
  - Particularly for metastatic disease or when patients are considered unsuitable for surgery
  - Based on low- to moderate-quality evidence
- However, guidelines also highlight the need for future clinical trials on the use of SBRT in renal cancer

Pancreatic Cancer

- 2012 report
  - Overall strength of evidence assessed as very low for effectiveness and harms, based on 1 systematic review and 4 case series
- 2023 update
  - 3 comparative NRSs

Pancreatic Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. CT or IMRT for unresected pancreatic cancer			
Overall survival			
N = 14,331 1 comparative NRS	In people with unresected pancreatic cancer treated with SBRT had significantly better overall survival than people treated with CT (13.9 months SBRT vs. 10.2 months CT; *P* < .001) or IMRT (13.9 months SBRT vs. 12.2 months IMRT; *P* = .049). However, there was no difference in overall survival between SBRT with multi-agent CT and multi-agent CT alone (14.8 months SBRT with multi-agent CT vs. 12.9 months multi-agent CT alone; *P* = .09).	⨁⨁◯◯ LOW	Not downgraded

Pancreatic Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. cRT for locally advanced pancreatic cancer			
Overall survival			
N = 8,450 1 comparative NRS	People with locally advanced pancreatic cancer treated with SBRT had significantly better overall survival than people treated with cRT at 2 years (HR, 0.84; 95% CI, 0.75 to 0.93), with a significantly longer median survival.	⨁⨁◯◯ LOW	Not downgraded

Pancreatic Cancer

- Based on the studies included in this review, we conclude that SBRT:
  - May be more effective than chemotherapy or intensity-modulated radiation therapy for unresected pancreatic cancer (low CoE, based on 1 comparative NRS)
  - May be more effective than conventional RT for pancreatic cancer (low CoE, based on 3 comparative NRSs)

Pancreatic Cancer

- 2019 ASTRO
  - Conditional recommendations on the use of SBRT as an option for treating pancreatic cancer
  - Based on very low- to low-quality evidence
  - Following surgical resection, SBRT should only be used in the context of research

Head and Neck Cancers

- 2012 report
  - Overall strength of evidence assessed as very low for harms for head and neck cancers (specifically, ocular and glomus jugulare), based on 1 systematic review and 7 case series
  - No comparative effectiveness studies were identified
- 2023 update
  - 1 RCT
  - 4 comparative NRSs

Head and Neck Cancers

Citation Setting NCT or Other Trial ID	Duration Risk-of-bias	Patient Characteristics	Description of Intervention	Description of Comparator(s)
Randomized controlled trials				
McBride et al., 2021 Single center in the US **NCT02684253**	RCT Median follow-up of 20 months Moderate risk-of-bias	Total N = 62 people with metastatic or recurrent head and neck squamous cell carcinoma, comprising 32 in SBRT group and 30 in control group	• SBRT in combination with nivolumab ◦ 9 Gy in 3 fractions delivered every other day	• Nivolumab

Head and Neck Cancers

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. brachytherapy in early-stage oropharyngeal cancer			
Overall survival			
N = 250 1 comparative NRS	SBRT boost or brachytherapy boost after cRT were associated with a similar overall survival at 3 years (81% SBRT vs. 83% BT; *P* = .83).	⊕⊕◯◯ LOW	Not downgraded
Progression-free survival			
N = 250 1 comparative NRS	SBRT boost or brachytherapy boost after cRT were associated with a similar disease-free survival at 3 years (92% SBRT vs. 86% BT; *P* = .15).	⊕⊕◯◯ LOW	Not downgraded
Disease-control			
N = 250 1 comparative NRS	SBRT boost or brachytherapy boost after cRT were associated with a similar local control rate at 3 years (97% SBRT vs. 94% BT; *P* = .33).	⊕⊕◯◯ LOW	Not downgraded
Quality of life			
N = 250 1 comparative NRS	No significant difference in quality of life in patients with early-stage oropharyngeal cancer boosted with SBRT or brachytherapy after cRT.	⊕⊕◯◯ LOW	Downgraded 1 level for imprecision (i.e., not assessable)

Head and Neck Cancers

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. other treatment options for recurrent or metastatic head and neck cancer			
Overall survival			
N = 62 1 RCT	No difference between nivolumab in combination with SBRT or nivolumab alone (at 12 months, 54.4% SBRT vs. 50.2% control; *P* = .75)	⨁⨁⨁◯ MODERATE	Downgraded 1 level for imprecision (i.e., not assessable)
N = 641 3 comparative NRSs	SBRT appears to be associated with a significantly worse overall survival than charged particle RT, (HR, 0.35; 95% CI, 0.13 to 0.94), but a similar cancer-specific survival to IMRT (HR, 0.88; 95% CI, 0.70 to 1.10) and conformal RT (at 2 years, 64% SBRT vs. 47% conformal RT; *P* = .40).	⨁⨁◯◯ LOW	Not downgraded

Head and Neck Cancers

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. other treatment options for recurrent or metastatic head and neck cancer			
Progression-free survival			
N = 62 1 RCT	No difference between nivolumab in combination with SBRT or nivolumab alone (at 12 months, 16.8% SBRT vs. 32.2% control; *P* = .79)	⊕⊕⊕◯ MODERATE	Downgraded 1 level for imprecision (i.e., not assessable)
Disease-control			
N = 62 1 RCT	No difference between nivolumab in combination with SBRT or nivolumab alone (at 12 months, OR, 0.80; 95% CI, 0.24 to 2.61)	⊕⊕◯◯ LOW	Downgraded 2 levels for imprecision (i.e., very wide CIs)[a]
N = 641 3 comparative NRSs	SBRT appears to be associated with similar levels of disease control to IMRT (HR, 1.15; 95% CI, 0.89 to 1.50), conformal RT (at 2 years, 82% SBRT; 80% conformal RT; *P* = .57), and charged particle RT (at 1 year, 67% SBRT vs. 67% charged particle RT; *P* value not reported)	⊕⊕◯◯ LOW	Not downgraded

Head and Neck Cancers

- Based on the studies included in this review, we conclude that SBRT:
  - May be similarly effective to brachytherapy, when used as a boost treatment after cRT for early-stage oropharyngeal cancer (low CoE, based on 1 comparative NRS)
  - May be less effective than charged particle RT for recurrent or metastatic head and neck cancer, but similar in effectiveness to intensity-modulated RT (IMRT) and conformal RT (low to moderate CoE, based on 1 RCT and 3 comparative NRSs)

Head and Neck Cancers

- No eligible guidelines identified

Liver Cancer

- 2012 report
  - Evidence assessed as being of very low certainty, with any conclusions about benefit and harms being uncertain, based on 2 systematic reviews of case series and 7 case series
- 2023 update
  - 20 comparative NRSs
  - *11 noncomparative studies (harms only)*

Liver Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. RFA for early-stage HCC			
Overall survival			
N = 4,892 4 comparative NRSs	In people with early-stage HCC, results were mixed. SBRT may be associated with similar overall survival to RFA (at 5 years, 78.4% vs. 46.3%; *P* = .09 over the 5 years); however, 1 study showed that SBRT may be associated with worse survival than RFA at 5 years (HR, 0.67; 95% CI, 0.55 to 0.81).	⨁◯◯◯ VERY LOW	Downgraded 1 level for inconsistency (i.e., mixed results)
Progression-free survival			
N = 98 1 comparative NRS	In people with early-stage HCC, SBRT after RFA may be associated with similar PFS to repeated RFA (at 2 years, 31.4% vs. 28.6%; *P* = .31).	⨁◯◯◯ VERY LOW	Downgraded 1 level for imprecision (i.e., not assessable)
Disease-control			
N = 472 2 comparative NRSs	In people with early-stage HCC, SBRT may be associated with similar rates of intrahepatic recurrence (at 3 years, 59.3% RT vs. 57.6% RFA; *P* = .64) and local recurrence (0 SBRT vs. 25.7% RFA; *P* = .06).	⨁⨁◯◯ LOW	Not downgraded

Liver Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. TACE and RFA in small HCCs			
Overall survival			
N = 683 4 comparative NRSs	In people with small HCCs, SBRT, alone or in combination with TACE is associated with a similar overall survival to TACE alone, TACE in combination with TACE, or to RFA. Studies reported at different times using different statistics, precluding any summary statistics (see detailed findings below).	⨁◯◯◯ VERY LOW	Downgraded 1 level for imprecision (i.e., wide CIs)
Progression-free survival			
N = 615 3 comparative NRSs	In people with small HCCs, SBRT is associated with a similar PFS to RFA. SBRT in combination with TACE is associated with similar or improved PFS to TACE alone or SBRT alone. Studies reported at different times using different statistics, precluding any summary statistics (see detailed findings below).	⨁⨁◯◯ LOW	Not downgraded

Liver Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. TACE and RFA in small HCCs			
Disease-control			
N = 683 4 comparative NRSs	In people with small HCC, SBRT added to TACE appears to be associated with improved local control, but results are mixed. Studies reported at different times using different statistics, precluding any summary statistics (see detailed findings below).	⨁◯◯◯ VERY LOW	Downgraded 1 level for inconsistency (i.e., mixed results)

Liver Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. other treatments for unresectable HCC			
Overall survival			
N = 3,338 8 comparative NRSs	In people with unresectable HCC, SBRT, alone or in combination with TACE, appears to be associated with similar or improved survival compared with TACE alone, RFA, or SIRT. When compared with TA, SBRT appears to be associated with a lower survival rate. Studies reported at different times using different statistics, precluding any summary statistics (see detailed findings below).	⨁⨁◯◯ LOW	Not downgraded
Progression-free survival			
N = 889 5 comparative NRSs	In people with unresectable HCC, SBRT, alone or in combination with TACE, appears to be associated with similar or improved PFS compared with TACE alone, RFA, or SIRT. When compared with TA, SBRT appears to be associated with a lower PFS. Studies reported at different times using different statistics, precluding any summary statistics (see detailed findings below).	⨁⨁◯◯ LOW	Not downgraded

Liver Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. other treatments for unresectable HCC			
Disease-control			
N = 3,149 8 comparative NRSs	In people with unresectable HCC, SBRT, alone or in combination with TACE, may have similar or improved rates of disease control and recurrence when compared with RFA or TACE alone. When compared with TA, results are mixed, with 1 study showing no difference and 1 showing a significant decrease in local control with SBRT. Studies reported at different times using different statistics, precluding any summary statistics (see detailed findings below).	⨁⨁◯◯ LOW	Not downgraded

Liver Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. sorafenib for advanced HCC			
Overall survival			
N = 1,023 1 comparative NRS	In people with advanced HCC, SBRT was associated with improved survival when compared with sorafenib (HR, 0.53; 95% CI, 0.36 to 0.77)	⨁⨁◯◯ LOW	Not downgraded[a]
Progression-free survival			
N = 1,023 1 comparative NRS	In people with advanced HCC, SBRT was associated with improved PFS when compared with sorafenib (HR, 0.59; 95% CI, 0.42 to 0.86)	⨁◯◯◯ VERY LOW	Downgraded 1 level imprecision (i.e., wide CIs)[a]

Liver Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. other treatment as bridging therapy for people on waiting list for liver transplantation due to HCC			
Overall survival			
N = 744 2 comparative NRSs	SBRT, as bridge therapy, appears to be associated with a similar overall survival to other options for bridge therapy (TACE, RFA, or HIFU; at around 61% to 73% at 3 years).	⨁⨁◯◯ LOW	Not downgraded
Progression-free survival			
N = 150 1 comparative NRS	SBRT, as bridge therapy, appears to be associated with improved PFS when compared with TACE or HIFU (progression at 3 years, 18.5% SBRT vs. 54.9% TACE vs. 62.8% HIFU; *P* < .001).	⨁◯◯◯ VERY LOW	Downgraded 1 level for imprecision (i.e., not assessable)[a]
Disease-control			
N = 744 2 comparative NRSs	SBRT, as bridge therapy, appears to be associated with a better disease control than other options for bridge therapy (TACE or HIFU) but may be associated with worse disease control than RFA. Studies reported at different times using different statistics, precluding any summary statistics (see detailed findings below).	⨁◯◯◯ VERY LOW	Downgraded 1 level for imprecision (i.e., not assessable)[a]

Liver Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. TARE or cRT for unresectable intrahepatic cholangiocarcinoma			
Overall survival			
N = 141 1 comparative NRS	SBRT was associated with improved survival compared with TARE (HR, 0.40; 95% CI, 0.22 to 0.74) or cRT (HR, 0.37; 95% CI, 0.20 to 0.68)	⨁⨁◯◯ LOW	Not downgraded

Liver Cancer

- Based on the studies included in this review, we conclude that SBRT:
  - May be as effective as radiofrequency ablation (RFA) for early-stage liver cancer; however, results were mixed (**very low** to **low** CoE, based on 4 comparative NRSs)
  - Alone, or in combination with transarterial chemoembolization (TACE), may be as effective as RFA or TACE alone for small liver cancers (**very low** to **low** CoE, based on 4 comparative NRSs) and for unresectable liver cancer (**low** CoE, based on 8 comparative NRSs)
  - May be more effective than sorafenib for advanced liver cancer (**very low** to **low** CoE, based on 1 comparative NRS)

Liver Cancer

- Based on the studies included in this review, we conclude that SBRT:
  - May be similarly or more effective than other options (RFA, TACE, high-intensity focused ultrasound [HIFU]) when used as a bridging therapy for people on the waiting list for liver transplantation due to liver cancer (**very low** to **low** CoE, based on 2 comparative NRSs)
  - May be more effective than sorafenib for advanced liver cancer (**very low** to **low** CoE, based on 1 comparative NRS)
  - May be more effective than transarterial radioembolization (TARE) for unresectable intrahepatic cholangiocarcinoma (**low** CoE, based on 1 comparative NRS)

Liver Cancer

- For biliary tract cancer
  - SBRT is conditionally recommended in specific situations
  - Based on low to moderate evidence quality
- For hepatocellular carcinoma
  - SBRT is an alternative for treatment of local failure in certain tumors
  - Based on low to moderate evidence quality
- 2022 American College of Radiology (ACR) appropriateness criteria
  - SBRT may be appropriate for a range of specific hepatocellular cancer types
  - Strength of evidence is not reported

Oligometastatic Cancer

- 2012 report
  - Included 2 noncomparative studies
  - No specific coverage determinations were made
- 2023 update
  - 3 RCTs
  - 3 comparative NRSs
  - *12 noncomparative studies (harms only)*

Oligometastatic Cancer

Citation Setting NCT or Other Trial ID or Study Name	Duration Risk-of-bias	Patient Characteristics	Intervention	Comparator(s)
Randomized controlled trials				
Ost et al., 2017 6 centers, including academic centers, in Belgium **NCT01558427** **STOMP**	Median follow-up of 3 years Moderate risk-of-bias	Total N = 62 men with recurrent oligometastatic prostate cancer, comprising 31 in treatment arm (majority received SBRT; remainder underwent surgery) and 31 in active surveillance arm	• SBRT ◦ Total dose of 30 Gy (80%of maximal dose) delivered in 3 fractions ◦ 25 (81%) • Metastectomy ◦ 6 (19%)	• Surveillance
Palma et al., 2019 10 hospitals in Canada, the Netherlands, Scotland, and Australia **NCT01446744** **SABR-COMET**	Followed up to 10 years Moderate risk-of-bias	Total N = 99 people with a controlled primary tumor and 1 to 5 oligometastatic lesions, comprising 66 in SBRT group and 33 in control group Primary sites were mostly adrenal, bone, liver, and lung	• SBRT ◦ Doses ranged from 30 to 60 Gy in 3 to 8 fractions, depending on target size and location ◦ Single fractions of 16 to 24 Gy permitted for targets in brain and vertebrae ◦ Concurrent chemotherapy or targeted therapy was not permitted within 4 weeks before SBRT • Standard of care, tailored to individual clinical circumstance	• Standard of care, tailored to individual clinical circumstance • Radiotherapy delivered according to standard principles of palliative radiation, with goal of alleviating symptoms or preventing anticipated complications of progression

Oligometastatic Cancer

Citation Setting NCT or Other Trial ID or Study Name	Duration Risk-of-bias	Patient Characteristics	Intervention	Comparator(s)
Randomized controlled trials				
Phillips et al., 2020 3 academic centers in the US **NCT02680587** **ORIOLE**	Followed up to 24 months Moderate risk-of-bias	Total N = 54 men with oligometastatic prostate cancer, comprising 36 in group and 18 in observation group	• SBRT ◦ Dose and fractionation based on size and location of each lesion, with prescription doses ranging from 19.5 to 48.0 Gy in 3 to 5 fractions ◦ Salvage RT was allowed ◦ Patients were allowed to have received ADT or other systemic therapy during initial management or salvage treatment but not within 6 months of enrollment	• Observation ◦ Salvage RT was allowed ◦ Patients were allowed to have received ADT or other systemic therapy during initial management or salvage treatment but not within 6 months of enrollment

Oligometastatic Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. standard of care for oligometastatic cancer (primaries mostly adrenal, bone, liver, and lung)			
Overall survival			
N = 99 1 RCT	At 5 years, no difference between groups (HR, 0.57; 95% CI, 0.30 to 1.10) At 6 years, improved survival with SBRT (HR, 0.47; 95% CI, 0.27 to 0.81)	⨁⨁⨁◯ MODERATE	Downgraded 1 level for imprecision (i.e., wide CIs)
Progression-free survival			
N = 99 1 RCT	At 5 years, improved PFS with SBRT (HR, 0.47; 95% CI, 0.30 to 0.76) At 6 years, improved PFS with SBRT (HR, 0.48; 95% CI, 0.31 to 0.76)	⨁⨁⨁◯ MODERATE	Downgraded 1 level for risk-of-bias
Disease-control			
N = 99 1 RCT	SBRT is associated with improved disease control (absence of progression, 75% SBRT vs. 49% standard of care; *P* = .001; lesional control by location).	⨁⨁◯◯ LOW	Downgraded 1 level each for risk-of-bias and imprecision (i.e., not assessable)
Quality of life			
N = 99 1 RCT	People with a controlled primary tumor and 1 to 5 oligometastatic lesions treated with SBRT or standard of care had a similar quality of life at each subsequent follow-up.	⨁⨁◯◯ LOW	Downgraded 1 level each for risk-of-bias and imprecision (i.e., not assessable)

Oligometastatic Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. observation for oligometastatic prostate cancer			
Overall survival			
N = 116 2 RCTs	In a pooled analysis of 2 RCTs, the median for overall survival was not reached in either group, with similar overall survival between groups (HR, 0.53; 95% CI, 0.13 to 2.11).	⨁⨁◯◯ LOW	Downgraded 2 levels for imprecision (i.e., very wide CIs)
Progression-free survival			
N = 116 2 RCTs	SBRT may be associated with similar or improved PFS (11.9 months MDT vs. 5.9 months surveillance; HR, 0.44; 95% CI, 0.29 to 0.66), and other measures of disease-related survival (ADT-free and castration-resistant prostate cancer-free survival).	⨁⨁◯◯ LOW	Downgraded 1 level each for risk-of-bias and imprecision (i.e., wide CIs)
Disease-control			
N = 54 1 RCT	Men treated with SBRT had higher complete response (28% SBRT vs. 8% observation) and partial response rates (43% vs. 39% observation) at 6 months; however, no formal statistical testing was reported.	⨁⨁◯◯ LOW	Downgraded 1 level each for risk-of-bias and imprecision (i.e., not assessable)
Quality of life			
N = 116 2 RCTs	No difference between groups.	⨁⨁◯◯ LOW	Downgraded 1 level each for risk-of-bias and imprecision (i.e., not assessable)

Oligometastatic Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. RT or no SBRT for oligometastatic prostate cancer			
Overall survival			
N = 506 1 comparative NRS	Men with oligometastatic or oligorecurrent prostate cancer treated with SBRT or cRT had a similar overall survival at 2 years (87.7% SBRT vs. 87.3% cRT; *P* = .91)	⨁⨁◯◯ LOW	Not downgraded[a]
Progression-free survival			
N = 682 2 comparative NRSs	SBRT appears to be associated with a worse metastasis-free survival when compared with elective nodal RT but similar or improved PFS when compared with cRT.	⨁◯◯◯ VERY LOW	Downgraded 1 level for imprecision (i.e., not assessable)
Disease-control			
N = 239 2 comparative NRSs	SBRT appears to be associated with worse outcomes (local and lymph node progression, relapse) when compared with elective nodal RT (68% SBRT vs. 77% with elective nodal RT; *P* = .01) but similar or improved outcomes (time to ADT or castration-resistance) when compared with no SBRT.	⨁◯◯◯ VERY LOW	Downgraded 1 level for imprecision (i.e., not assessable)

Oligometastatic Cancer

- Based on the studies included in this review, we conclude that SBRT:
  - Appears to be more effective than standard of care or observation for oligometastatic cancer (**low** to **moderate** CoE, based on 3 RCTs)
  - For oligometastatic prostate cancer, elective nodal radiation therapy may be more effective than SBRT (**very low** to **low** CoE, based on 3 comparative NRSs)

Oligometastatic Cancer

- No eligible guidelines identified

Adrenal Cancer

- 2012 report
  - Overall strength of evidence was assessed as very low for effectiveness and harms for adrenal metastases, based on 2 case series
- 2023 update
  - *1 noncomparative study (harms only)*
- No eligible guidelines identified

Bone Cancer

- 2012 report
  - No included studies other than for spine cancers (a covered indication)
- 2023 update
  - 1 RCT

Bone Cancer

Citation Setting NCT or Other Trial ID	Duration Risk of Bias	Patient Characteristics	Description of Intervention	Description of Comparator(s)
Nguyen et al., 2019 Single academic center in the US **NCT02163226**	Followed up to 24 months Moderate risk of bias	Total N = 160 people with radiologically confirmed painful bone metastases, comprising 81 in the SBRT group and in the 79 control group	• SBRT ◦ Single-fraction 12 Gy for lesions > 4 cm or 16 Gy for lesions ≤4 cm ◦ Standard concurrent chemotherapy, immunotherapy, or targeted therapy was allowed	• Standard MFRT ◦ 30 Gy delivered in 10 3-Gy fractions ◦ Standard concurrent chemotherapy, immunotherapy, or targeted therapy was allowed

Bone Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. cRT for bone metastases			
Overall survival			
N = 160 1 RCT	People with radiologically confirmed painful bone metastases (mostly nonspine) treated with SBRT or MFRT had a similar overall survival (median, 6.7 months in both groups).	⨁⨁⨁◯ MODERATE	Downgraded 1 level imprecision (i.e., not assessable)
Disease-control			
N = 160 1 RCT	When compared with MFRT, SBRT was found to be noninferior for both local failure (HR, 0.18; 95% CI, 0.02 to 1.47).	⨁◯◯◯ VERY LOW	Downgraded 1 level for risk of bias and 2 levels for imprecision (i.e., very wide CIs)
Quality of life			
N = 160 1 RCT	No significant difference in quality of life for patients treated with SBRT or with MFRT.	⨁⨁◯◯ LOW	Downgraded 1 level each for risk of bias and imprecision (i.e., not assessable)

Bone Cancer

- Based on the studies included in this review, we conclude that SBRT:
  - May be as effective as multifraction RT for painful bone metastases (**moderate** CoE, based on 1 RCT)

Bone Cancer

- For nonspine bone cancer, guidelines recommend
  - SBRT is considered as an option, particularly for localized or metastatic disease
  - Evidence quality, when provided, is low

Subgroups

- Few studies reported on clinical subgroups of interest, but there was some indication specific populations (by cancer site) may be more likely to benefit from SBRT compared with other populations
  - Subgroups varied by cancer type and treatment site and were often only reported in single studies

Guideline Recommendations

- Guidelines recommend SBRT as an option for metastases of colorectal cancer, particularly in people who are not considered candidates for surgery
- Eligible guidelines make conditional recommendations for use of SBRT for certain groups of patients with gynaecological cancers, specifically those with metastases or who are at high surgical risk
  - Evidence quality, when provided, was low
- For testicular cancer, SBRT is considered as an option for salvage treatment
  - Strength of recommendation not provided

Findings

Key Questions 2 and 3: Toxicity

Prostate Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. other forms of RT for localized prostate cancer (all risk groups)			
Toxicity			
N = 2,409 4 RCTs	Rates of toxicities of grade 3 or higher were relatively infrequent in SBRT for localized prostate cancer (around 1% to 2%), and were similar to those of other RTs.	⨁⨁⨁◯ MODERATE	Downgraded 1 level for risk-of-bias
N = 67,968 5 comparative NRSs	Overall, grade 3 toxicities were rare (up to 6% depending on the specific toxicity and the time point) and no grade 4 or 5 events were reported when SBRT was used for localized prostate cancer (all risk groups). There may be some evidence SBRT is associated with increased urinary retention or obstruction, urinary fistula, and more GI and GU toxicity than IMRT, and greater GI toxicity than brachytherapy.	⨁⨁◯◯ LOW	Not downgraded

Lung Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. surgery and other RT for any lung cancer			
Toxicity			
N = 138 2 RCTs	Grade 3 and higher events occurred in around 3% to 11% of SBRT group; most common were dyspnea and pneumonia, pancreatitis, and fatigue.	⨁⨁⨁◯ MODERATE	Downgraded 1 level for risk-of-bias
N = 221 2 comparative NRSs	Grade 3 toxicities were not common with SBRT, and included lung toxicity (including radiation pneumonitis) and chest wall pain; ranging from 3% to 14% depending on the specific toxicity.	⨁⨁◯◯ LOW	Not downgraded

Melanoma

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT with nivolumab and ipilimumab vs. nivolumab and ipilimumab for Merkel cell carcinoma			
Toxicity			
N = 50 1 RCT	8 (16%) discontinued the protocol treatment due to toxicity. No deaths were attributed to treatment. Grade 3 events occurred in 24% of SBRT group and 28% in control group; grade 4 events occurred in 8% and 12% by group.	⊕⊕◯◯ LOW	Downgraded 1 level each for risk-of-bias and for imprecision (i.e., not assessable)

Renal Cell Carcinoma

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. cRT in stage I RCC			
Overall survival			
Toxicity			
N = 190 1 noncomparative NRS	Fewer than 1% of participants experienced a grade 3 or higher toxicity	⨁◯◯◯ VERY LOW	Downgraded 1 level of risk of bias (i.e., high risk of bias) and imprecision (i.e., not assessable)

Pancreatic Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. CT or cRT for pancreatic cancer			
Toxicity			
N = 5,624 1 comparative NRS	In people with nonmetastatic, unresectable pancreatic cancer, SBRT was associated with significantly more GI bleeds than CT alone (HR, 4.13; 95% CI, 2.58 to 6.61) and GI strictures (HR, 1.58; 95% CI, 1.18 to 2.21). However, risk varied by age, with SBRT being associated with similar rates of GI complications to cRT in younger people.	⨁⨁◯◯ LOW	Not downgraded

Head and Neck Cancers

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. other options for early and recurrent head and neck cancers			
Toxicity			
N = 62 1 RCT	No difference between nivolumab in combination with SBRT or nivolumab alone (grade 3, and higher 9.7% SBRT vs. 13.3% control; *P* = .70)	⨁⨁⨁◯ MODERATE	Downgraded 1 level for imprecision (i.e., not assessable)
N = 891 4 comparative NRSs	SBRT had a favorable toxicity profile, with similar or fewer toxicities than other treatment options (brachytherapy, conformal RT, IMRT, charged particle RT); however, grade 5 events were relatively high, with 1 study reporting 12.5% grade 5 events in the SBRT group	⨁⨁◯◯ LOW	Not downgraded

Liver Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. other treatments for HCC			
Toxicity			
N = 6,071 16 comparative NRSs	Rates of toxicities of grade 3 or higher were relatively infrequent in SBRT, and were similar to those of other RTs or treatment options. SBRT may be associated with some increased toxicities, but it is also associated with some decreased toxicities when compared with other options. Rates of toxicities varied by type of toxicity and time frame.	⊕⊕◯◯ LOW	Not downgraded

Oligometastatic Cancers

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. other treatment for oligometastatic cancer (primary sites included prostate, breast, lung, and other sites)			
Toxicity			
N = 215 3 RCTs	No grade 3 and higher toxicities were seen in 2 of the 3 trials, but some SBRT-related deaths were observed.	⨁⨁◯◯ LOW	Downgraded 1 level each for risk-of-bias and imprecision (i.e., not assessable)
N = 745 3 comparative NRSs	No grade 3 and higher toxicities were reported, lower than those experienced with elective nodal RT (up to 2%).	⨁◯◯◯ VERY LOW	Downgraded 1 level for imprecision (i.e., not assessable)

Bone Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
Toxicity			
N = 160 1 RCT	No significant difference in toxicities for patients treated with SBRT or with MFRT. SBRT was associated with around 1% grade 3 or higher toxicities, and up to 10% for fatigue grade 3 and higher.	⨁⨁◯◯ LOW	Downgraded 1 level each for risk of bias and imprecision (i.e., not assessable)

Large Tumors

- 2012 report
  - No included studies
- 2023 update
  - *1 noncomparative study (harms only)*

Mixed Tumors

- 2012 report
  - No comparative studies were identified on mixed or multiple cancer sites
  - Included 5 case series for multiple tumor sites
  - Overall strength of evidence was very low for effectiveness and harms
- 2023 update
  - *2 noncomparative studies (harms only)*

Toxicity and Harms

- Overall, SBRT was not associated with significantly higher rates of toxicity than other treatment options
  - Types of toxicity varied by treatment site
  - Events classed as grade 4 and 5 toxicities were rare
- No comparative toxicity for adrenal or renal cancers, large tumors, or mixed tumors
- Very few reports in the FDA's Medical Device Recall database were classified as Class 1 (defined as a situation where there is a reasonable chance that a product will cause serious health problems or death)
  - Related to software and placement issues
- Similar safety issues were reported to the FDA's MAUDE database

Subgroups

- Few studies reported on clinical subgroups of interest, but there was some indication specific populations (by cancer site) may be more at risk of SBRT-related toxicity compared with other populations
  - Varied by cancer type and treatment site and were often only reported in single studies

Clinical Practice Guidelines

- Recommendations on the use of SBRT and payer policies varied in approach to the use of SBRT, with some guidelines or policies being more supportive of the use of SBRT depending on the cancer site
- Guidelines and payer policies often noted the limited evidence base, but also highlighted that SBRT may be preferred by patients because of fewer treatment fractions, and favorable safety profile

Findings

Key Questions 4: Costs and Cost-Effectiveness

Prostate Cancer

Study ID Study Risk-of-bias	Population	Intervention	Comparators	Economic Analytic Method
Pan et al., 2018 Low risk-of-bias	Men with localized prostate cancer	• SBRT	• IMRT	Cost comparison
Parikh et al., 2020 Low risk-of-bias	Men with oligorecurrent hormone-sensitive prostate cancer	• SBRT	• Abiraterone acetate plus prednisone and ADT • Docetaxel and ADT	Cost-effectiveness analysis (Markov state transition model)

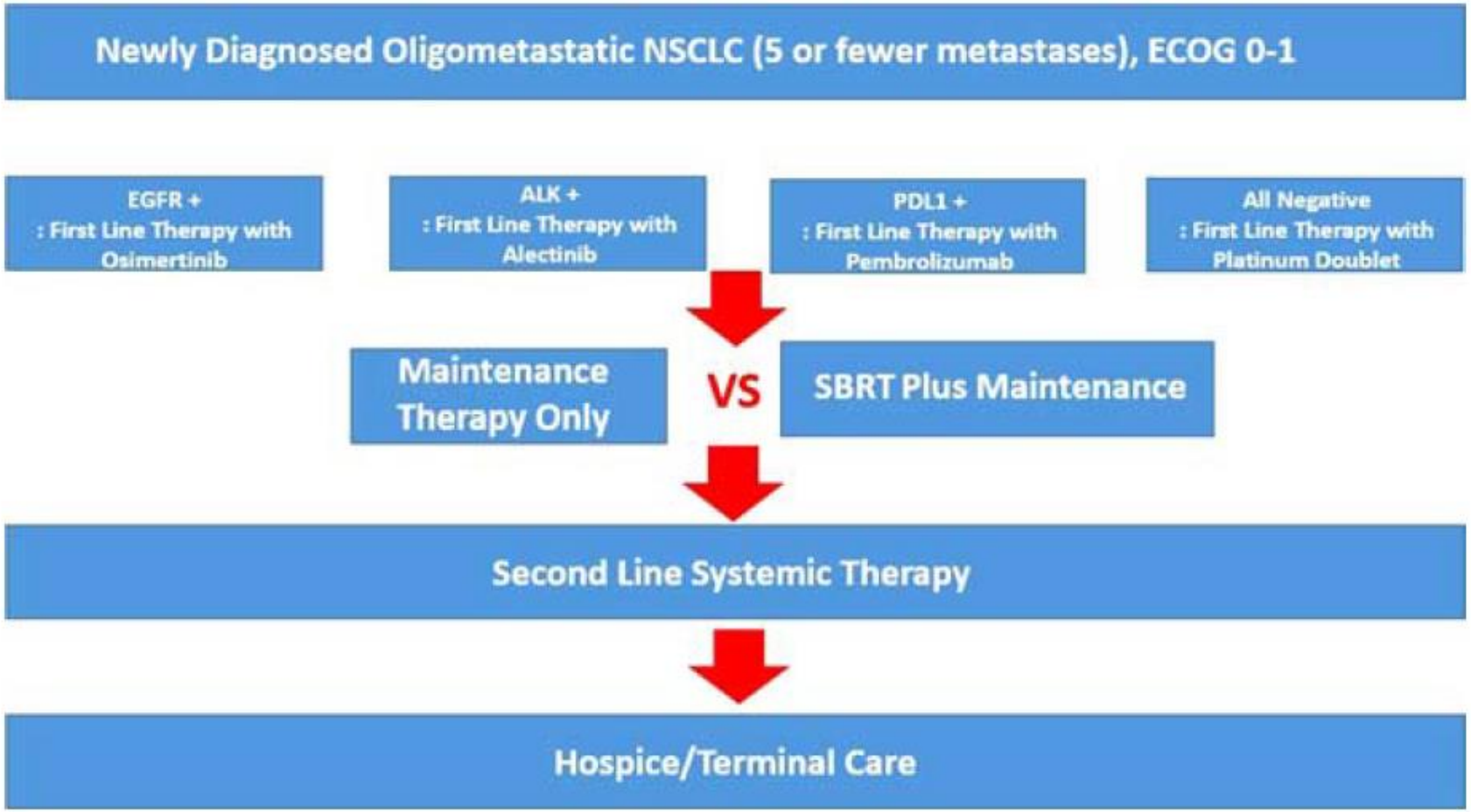
Prostate Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. IMRT for prostate cancer			
Outcome: cost-effectiveness			
N = 3 hypothetical cohorts 1 economic modelling study	Upfront SBRT may be a cost-effective option for people who wish to avoid systemic therapy; however, it was the cost-effective strategy in only 53.6% of microsimulations at a WTP of $100,000 per QALY	⨁⨁◯◯ LOW	Downgraded 1 level for indirectness (i.e., oligometastatic hormone-resistant prostate cancer) and for imprecision (i.e., wide CIs)
Outcome: costs			
N = 12,128 1 comparative NRS	SBRT had lower costs for both the payer ($49,504 for SBRT and $57,244 for IMRT; *P* < .001) and patient than IMRT ($1,015 for SBRT and $1,560 for IMRT; *P* < .001) No difference between treatments in complication costs or overall health care costs at 2 years	⨁◯◯◯ VERY LOW	Downgraded 1 level for indirectness (i.e., localized prostate cancer in younger men with private insurance)

Lung Cancer

Study ID Study Risk-of-bias	Population	Intervention	Comparators	Economic Analytic Method
Kim et al., 2019 Low risk-of-bias	People with oligometastatic stage IV NSCLC, grouped by mutation status	• SBRT plus maintenance therapy	• Maintenance therapy alone	Cost-effectiveness analysis (Markov state transition model)

Lung Cancer


Newly Diagnosed Oligometastatic NSCLC (5 or fewer metastases), ECOG 0-1
EGFR +
: First Line Therapy with Osimertinib
ALK +
: First Line Therapy with Alectinib
PDL1 +
: First Line Therapy with Pembrolizumab
All Negative
: First Line Therapy with Platinum Doublet
Maintenance Therapy Only
VS
SBRT Plus Maintenance
Second Line Systemic Therapy
Hospice/Terminal Care

Lung Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT plus maintenance therapy vs maintenance therapy for lung cancer			
Outcome: cost-effectiveness			
N = 3 hypothetical cohorts 1 economic modelling study	SBRT was assessed as not being cost-effective at a WTP threshold of $100,000 when added to maintenance therapy for people with oligometastatic NSCLC.	⨁⨁⨁◯ MODERATE	Downgraded 1 level for indirectness (i.e., oligometastatic NSCLC only, by mutation status)

Pancreatic Cancer

Study ID Study Risk-of-bias	Population	Intervention	Comparators	Economic Analytic Method
Moningi et al., 2022 Low risk-of-bias	People with non-metastatic, unresectable pancreatic cancer	• SBRT	• cRT • Chemotherapy	Cost comparison

Pancreatic Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. cRT or chemotherapy for pancreatic cancer			
Outcome: cost-effectiveness			
Not reported			
Outcome: costs			
N = 5,624 1 comparative NRS	Healthcare payments were greatest for SBRT when compared with cRT or chemotherapy under US Medicare ($P < .001$) and employer-based insurance ($P < .001$).	⨁◯◯◯ VERY LOW	Downgraded 1 level for indirectness (i.e., nonmetastatic, unresectable pancreatic cancer)

Head and Neck Cancers

Study ID Study Risk-of-bias	Population	Intervention	Comparators	Economic Analytic Method
Kim et al., 2018 Low risk-of-bias	People with unresectable locally recurrent previously irradiated head and neck cancers	• SBRT • SBRT plus cetuximab	• Platinum-based chemotherapy alone • Chemotherapy plus cetuximab • IMRT plus chemotherapy	Cost-effectiveness analysis (Markov state transition model)

Head and Neck Cancers

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT plus maintenance therapy vs salvage therapies for head and neck cancer			
Outcome: cost-effectiveness			
N = 1 hypothetical cohort 1 economic modelling study	None of treatment strategies were cost-effective. However, SBRT-based reirradiation has potential to be cost-effective, as model was sensitive to median survival.	⨁⨁⨁◯ MODERATE	Downgraded 1 level for indirectness (i.e., locoregional previously irradiated head and neck cancer)

Liver Cancer

Study ID Study Risk-of-bias	Population	Intervention	Comparators	Economic Analytic Method
Parikh et al., 2018 Low risk-of-bias	People with early-stage liver cancer	• SBRT	• RFA	Cost-effectiveness analysis

Liver Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. RFA for liver cancer			
Outcome: cost-effectiveness			
N = 440 1 comparative NRS, including a cost-effectiveness analysis	SBRT was not cost-effective compared with RFA in overall population of people with early-stage HCC; however, 85.5% of bootstrap ICER estimates were lower than WTP threshold of $100,000.	⨁⨁⨁◯ MODERATE	Downgraded 1 level for indirectness (i.e., early-stage HCC only)

Oligometastatic Cancers

Study ID Study Risk-of-bias	Population	Intervention	Comparators	Economic Analytic Method
Kumar et al., 2021 Low risk-of-bias	People with oligometastatic disease	• SBRT	• Standard care	Cost-effectiveness analysis (Markov model)
Mehrens et al., 2021 Low risk-of-bias	People with oligometastatic disease	• SBRT	• Standard care	Cost-effectiveness analysis (partitioned survival model)

Oligometastatic Cancers

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. standard care for oligometastatic cancer			
Outcome: cost-effectiveness			
N = 2 hypothetical cohorts based on SABR-COMET data 2 economic modelling studies	Addition of SBRT increased costs and improved quality adjusted survival, overall leading to a cost-effective treatment strategy for patients with oligometastatic cancer.	⨁⨁⨁◯ MODERATE	Downgraded 1 level for indirectness (i.e., based on a single trial for patient outcomes)

Bone Cancer

Study ID Study Risk-of-bias	Population	Intervention	Comparators	Economic Analytic Method
Santos et al., 2021 Low risk of bias	People with bone metastases	• SBRT	• EBRT • IMRT	Cost comparison

Bone Cancer

Number of Participants (N) Number of Studies	Findings	Certainty of Evidence	Rationale
SBRT vs. other forms of RT for bone cancer			
Outcome: costs			
N = 40,993 cases 1 comparative NRS	For people with bone metastases, the cost of SBRT was significantly higher for both professional and technical fees ($679 lower provider costs and $6,422 lower technical costs for external beam RT; $36 lower provider costs and $2,534 lower technical costs for IMRT; *P* < .001).	⨁◯◯◯ VERY LOW	Downgraded 1 level for indirectness (i.e., no indication how many were nonspine metastases)

Costs and Cost-Effectiveness

- While the economic literature was sparse, SBRT appears to be:
  - Possibly cost-effective for **oligometastatic hormone-resistant prostate cancer** (low CoE, based on 1 economic modeling study)
  - Lower in costs than IMRT for **prostate cancer** (very low CoE, based on 1 comparative NRS)
  - Cost-ineffective when compared with maintenance therapy for **oligometastatic lung cancer** (moderate CoE, based on 1 economic modeling study)
  - Higher in costs than cRT or chemotherapy for **pancreatic cancer** (very low CoE, based on 1 comparative NRS)

Costs and Cost-Effectiveness

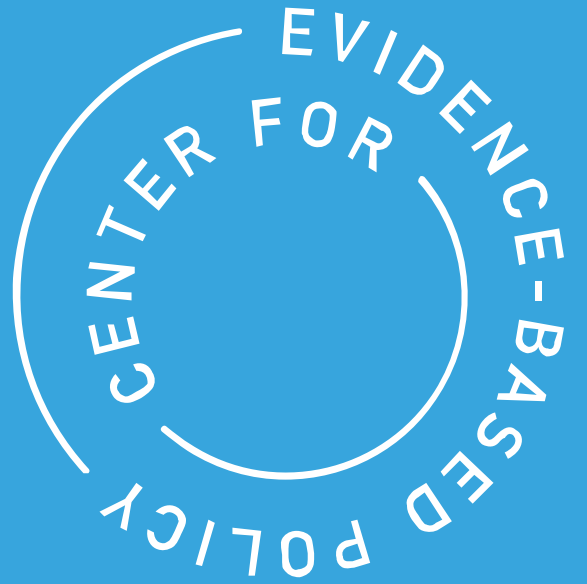
- While the economic literature was sparse, SBRT appears to be:
  - Cost-ineffective as reirradiation when compared with other salvage therapies, including IMRT with chemotherapy, for **head and neck cancers** (**moderate** CoE, based on 1 economic modeling study)
  - Cost-ineffective when compared with RFA for **liver cancer** (**low** CoE, based on 1 economic modeling study)
  - Cost-effective when compared with standard of care for **oligometastatic cancer** (**moderate** CoE, based on 2 economic modeling studies)
  - More expensive than EBRT and IMRT for **bone cancer** (**very low** CoE, based on 1 comparative NRS)
- No identified economic evidence in adrenal cancer or renal cancer

Conclusion

Conclusion

- For some cancer sites, evidence shows SBRT has the potential to be an effective option when compared with other treatment options
  - Varies by specific type of cancer and comparative care
- However, SBRT for other cancers remains unsupported with limited or no comparative evidence of effectiveness
- Some guidelines are more supportive of the use of SBRT, but most note the limited evidence base, highlighting it may be preferred by patients because of the fewer treatment fractions and the favorable safety profile of SBRT when compared with other treatment options

Questions?


CENTER FOR EVIDENCE-BASED POLICY

HTCC Coverage and Reimbursement Determination
Analytic Tool

HTA's goal is to achieve *better health care outcomes* for enrollees and beneficiaries of state programs by paying for proven health *technologies that work*.

To find best outcomes and value for the state and the patient, the HTA program focuses on three questions:

1. Is it safe?
2. Is it effective?
3. Does it provide value (improve health outcome)?

The principles HTCC uses to review evidence and make determinations are:

Principle One: Determinations are evidence-based

HTCC requires scientific evidence that a health technology is safe, effective and cost-effective[1] as expressed by the following standards[2]:

- Persons will experience better health outcomes than if the health technology was not covered and that the benefits outweigh the harms.
- The HTCC emphasizes evidence that directly links the technology with health outcomes. Indirect evidence may be sufficient if it supports the principal links in the analytic framework.
- Although the HTCC acknowledges that subjective judgments do enter into the evaluation of evidence and the weighing of benefits and harms, its recommendations are not based largely on opinion.
- The HTCC is explicit about the scientific evidence relied upon for its determinations.

Principle Two: Determinations result in health benefit

The outcomes critical to HTCC in making coverage and reimbursement determinations are health benefits and harms[3]:

- In considering potential benefits, the HTCC focuses on absolute reductions in the risk of outcomes that people can feel or care about.
- In considering potential harms, the HTCC examines harms of all types, including physical, psychological, and non-medical harms that may occur sooner or later as a result of the use of the technology.
- Where possible, the HTCC considers the feasibility of future widespread implementation of the technology in making recommendations.

Based on Legislative mandate: RCW 70.14.100(2).

The principles and standards are based on USPSTF Principles at: http://www.ahrq.gov/clinic/ajpmsuppl/harris3.htm

- The HTCC generally takes a population perspective in weighing the magnitude of benefits against the magnitude of harms. In some situations, it may make a determination for a technology with a large potential benefit for a small proportion of the population.
- In assessing net benefits, the HTCC subjectively estimates the indicated population's value for each benefit and harm. When the HTCC judges that the balance of benefits and harms is likely to vary substantially within the population, coverage or reimbursement determinations may be more selective based on the variation.
- The HTCC considers the economic costs of the health technology in making determinations, but costs are the lowest priority.

Using evidence as the basis for a coverage decision

Arrive at the coverage decision by identifying for Safety, Effectiveness, and Cost whether (1) evidence is available, (2) the confidence in the evidence, and (3) applicability to decision.

1. Availability of evidence:

Committee members identify the factors, often referred to as outcomes of interest, that are at issue around safety, effectiveness, and cost. Those deemed key factors are ones that impact the question of whether the particular technology improves health outcomes. Committee members then identify whether and what evidence is available related to each of the key factors.

2. Sufficiency of the evidence:

Committee members discuss and assess the evidence available and its relevance to the key factors by discussion of the type, quality, and relevance of the evidence[4] using characteristics such as:

- Type of evidence as reported in the technology assessment or other evidence presented to committee (randomized trials, observational studies, case series, expert opinion);
- The amount of evidence (sparse to many number of evidence or events or individuals studied);
- Consistency of evidence (results vary or largely similar);
- Recency (timeliness of information);
- Directness of evidence (link between technology and outcome);
- Relevance of evidence (applicability to agency program and clients);
- Bias (likelihood of conflict of interest or lack of safeguards).

Sufficiency or insufficiency of the evidence is a judgment of each clinical committee member and correlates closely to the GRADE confidence decision.

Not Confident	Confident
Appreciable uncertainty exists. Further information is needed or further information is likely to change confidence.	Very certain of evidentiary support. Further information is unlikely to change confidence

[4] Based on GRADE recommendation: http://www.gradeworkinggroup.org/FAQ/index.htm

3. *Factors for Consideration - Importance*

At the end of discussion a vote is taken on whether sufficient evidence exists regarding the technology's safety, effectiveness, and cost. The committee must weigh the degree of importance that each particular key factor and the evidence that supports it has to the policy and coverage decision. Valuing the level of importance is factor or outcome specific but most often include, for areas of safety, effectiveness, and cost:

- Risk of event occurring;
- The degree of harm associated with risk;
- The number of risks; the burden of the condition;
- Burden untreated or treated with alternatives;
- The importance of the outcome (e.g. treatment prevents death vs. relief of symptom);
- The degree of effect (e.g. relief of all, none, or some symptom, duration, etc.);
- Value variation based on patient preference.

Clinical committee findings and decisions

Efficacy considerations

- What is the evidence that use of the technology results in more beneficial, important health outcomes? Consider:
  - Direct outcome or surrogate measure
  - Short term or long term effect
  - Magnitude of effect
  - Impact on pain, functional restoration, quality of life
  - Disease management
- What is the evidence confirming that use of the technology results in a more beneficial outcome, compared to no treatment or placebo treatment?
- What is the evidence confirming that use of the technology results in a more beneficial outcome, compared to alternative treatment?
- What is the evidence of the magnitude of the benefit or the incremental value?
- Does the scientific evidence confirm that use of the technology can effectively replace other technologies or is this additive?
- For diagnostic tests, what is the evidence of a diagnostic tests' accuracy?
  - Does the use of the technology more accurately identify both those with the condition being evaluated and those without the condition being evaluated?
- Does the use of the technology result in better sensitivity and better specificity?
- Is there a tradeoff in sensitivity and specificity that on balance the diagnostic technology is thought to be more accurate than current diagnostic testing?
- Does use of the test change treatment choices?

Safety

- What is the evidence of the effect of using the technology on significant morbidity?
  - Frequent adverse effect on health, but unlikely to result in lasting harm or be life-threatening, or;
  - Adverse effect on health that can result in lasting harm or can be life-threatening?
- Other morbidity concerns?
- Short term or direct complication versus long term complications?
- What is the evidence of using the technology on mortality – does it result in fewer adverse non-fatal outcomes?

Cost impact

- Do the cost analyses show that use of the new technology will result in costs that are greater, equivalent or lower than management without use of the technology?

Overall

- What is the evidence about alternatives and comparisons to the alternatives?
- Does scientific evidence confirm that use of the technology results in better health outcomes than management without use of the technology?

Next step: Cover or no cover

If not covered, or covered unconditionally, the chair will instruct staff to write a proposed findings and decision document for review and final adoption at the following meeting.

Next step: Cover with conditions

If covered with conditions, the committee will continue discussion.

1) Does the committee have enough information to identify conditions or criteria?
   - Refer to evidence identification document and discussion.
   - Chair will facilitate discussion, and if enough members agree, conditions and/or criteria will be identified and listed.
   - Chair will instruct staff to write a proposed findings and decision document for review and final adoption at next meeting.
2) If not enough or appropriate information, then Chair will facilitate a discussion on the following:
   - What are the known conditions/criteria and evidence state
   - What issues need to be addressed and evidence state

The chair will delegate investigation and return to group based on information and issues identified. Information known but not available or assembled can be gathered by staff ; additional clinical questions may need further research by evidence center or may need ad hoc advisory group; information on agency utilization, similar coverage decisions may need agency or other health plan input; information on current practice in community or beneficiary preference may need further public input. Delegation should include specific instructions on the

task, assignment or issue; include a time frame; provide direction on membership or input if a group is to be convened.

Clinical committee evidence votes

First voting question

The HTCC has reviewed and considered the technology assessment and information provided by the administrator, reports and/or testimony from an advisory group, and submissions or comments from the public. The committee has given greatest weight to the evidence it determined, based on objective factors, to be the most valid and reliable.

Discussion document: What are the key factors and health outcomes and what evidence is there? (Applies to the population in the PICO for this review)

Safety outcomes	Importance of outcome	Safety evidence/ confidence in evidence
Toxicity		

Efficacy – effectiveness outcomes	Importance of outcome	Efficacy / Effectiveness evidence
Overall survival		
Progression-free survival		
Disease-free survival		
Quality of life		
Objective response rate		
Complete response rate		

Cost outcomes	Importance of outcome	Cost evidence
Cost		
Cost-effectiveness		

Special population / Considerations outcomes	Importance of outcome	Special populations/ Considerations evidence
Age		
Sex		
Comorbidity		
Adolescents		
Pregnant individuals		

For safety:

Is there sufficient evidence that the technology is safe for the indications considered?

Unproven (no)	Less (yes)	Equivalent (yes)	More in some (yes)	More in all (yes)

For efficacy/ effectiveness:

Is there sufficient evidence that the technology has a meaningful impact on patients and patient care?

Unproven (no)	Less (yes)	Equivalent (yes)	More in some (yes)	More in all (yes)

For cost outcomes/ cost-effectiveness:

Is there sufficient evidence that the technology is cost-effective for the indications considered?

Unproven (no)	Less (yes)	Equivalent (yes)	More in some (yes)	More in all (yes)

Discussion

Based on the evidence vote, the committee may be ready to take a vote on coverage or further discussion may be warranted to understand the differences of opinions or to discuss the implications of the vote on a final coverage decision.

- Evidence is insufficient to make a conclusion about whether the health technology is safe, efficacious, and cost-effective;
- Evidence is sufficient to conclude that the health technology is unsafe, ineffectual, or not cost-effective
- Evidence is sufficient to conclude that the health technology is safe, efficacious, and cost-effective for all indicated conditions;
- Evidence is sufficient to conclude that the health technology is safe, efficacious, and cost-effective for some conditions or in some situations

A straw vote may be taken to determine whether, and in what area, further discussion is necessary.

Second Vote

Based on the evidence about the technologies' safety, efficacy, and cost-effectiveness, it is:

Not covered	Covered unconditionally	Covered with conditions

Discussion item

Is the determination consistent with identified Medicare decisions and expert guidelines, and if not, what evidence is relied upon.

The report "identified no Medicare national coverage determination on the use of SBRT or any local coverage determinations that apply to the state of Washington."

Medicare Coverage

No Medicare National Coverage Determination (NCD)

Selected Payer Coverage Determinations

We identified no Medicare national coverage determination on the use of SBRT or any local coverage determinations that apply to the state of Washington.
Each of the 3 private payers that we reviewed, Aetna, Cigna, and, Regence, had coverage policies on the use of SBRT.[310]
Aetna considered SBRT as medically necessary in the following clinical conditions[310]:

- Stereotactic body radiation therapy with a CyberKnife, gamma knife, or linear accelerator (LINAC) is considered medically necessary for localized malignant conditions within the body where highly precise application of high-dose radiotherapy is required and clinically appropriate, including:
  - Hepatocellular carcinoma in individuals with unresectable disease considered extensive and not suitable for liver transplantation, or for individuals with local disease only with a good performance status (a score between 80 and 100 on the Karnofsky Performance Scale) but who are not amenable to surgery due to comorbidities
  - Prostate cancer in individuals with organ-confined prostate cancer with Gleason score less than or equal to 8 and prostate-specific antigen (PSA) less than 20

  - Non-small cell lung cancer for inoperable stage I or II tumors
  - Oligometastatic colorectal cancer (1 to 3 metastases to the lung or liver) not amenable to surgery
  - Inoperable primary spinal tumors with compression or intractable pain
  - Recurrent metastatic disease in a previously irradiated area
  - Recurrent localized head and neck cancer
  - Metastatic lesions to the liver when the sole site of disease and cannot be surgically resected or undergo accepted ablation techniques
  - Metastatic disease to the lung when clinically appropriate and on a case-by-case basis
- All other clinical sites or indications are considered experimental and investigational but will be considered on a case-by-case basis.
- Fractionated stereotactic radiotherapy is considered medically necessary when criteria for stereotactic radiosurgery are met. Fractionated stereotactic radiotherapy is useful for treatment of tumors in hard-to-reach locations, tumors with very unusual shapes, or for tumors located in such close proximity to a vital structure (e.g., optic nerve or hypothalamus) that even a very accurate high-dose single fraction of stereotactic radiosurgery could not be tolerated.

Aetna's coverage policy is due to be reviewed in early 2023.[310]
CIGNA has a series of recommendations on the use of the SBRT, reviewed in December of 2022[311]:

- Adrenal cancer
  - SBRT is considered not medically necessary in the adjuvant (post-operative) curative treatment of primary adrenocortical carcinoma.
- Bone metastases
  - SBRT using up to 5 fractions is considered not medically necessary for the treatment of bone metastases except in either of the following clinical scenarios:
    - Treatment to a portion of the spine that has been previously irradiated
    - Treatment of sarcoma, melanoma, and renal cell carcinoma that have metastasized to the spine. SBRT, as a complete course of therapy, must be completed in 5 fractions in a single episode of care.
  - SBRT is considered not to be medically necessary for all other bone metastases.
- Cervical cancer
  - SBRT as an alternative to brachytherapy is considered experimental, investigational, or unproven for the definitive treatment of cervical cancer.
  - SBRT is considered medically necessary based on a history of previous radiation to the same or abutting region and inability to deliver therapeutic doses of radiation with other techniques for locoregional recurrence of cervical cancer in an individual without evidence of distant metastases.
- Head and neck cancer
  - SBRT (up to 5 fractions) may be medically necessary for retreatment in an individual with head and neck cancer who has no evidence of metastatic disease. SBRT, as a complete course of therapy, must be completed in 5 fractions in a single episode of care.
- Liver and hepatobiliary cancer
  - The use of 3 to 5 fractions of SBRT is considered medically necessary to definitely treat concurrently 1 or more tumors in primary hepatocellular carcinoma when there is evidence of the ability to protect an adequate volume of uninvolved liver. SBRT, as a complete course of therapy, must be completed in 5 fractions in a single episode of care.
  - The use of up to 5 fractions of SBRT is considered medically necessary for the definitive treatment of intrahepatic bile duct cancer (cholangiocarcinoma).
  - The use of SBRT is considered not medically necessary for the definitive treatment of extrahepatic bile duct cancer (cholangiocarcinoma).
  - The use of SBRT is considered not medically necessary for adjuvant (postoperative) treatment of extrahepatic bile duct cancer (cholangiocarcinoma).
  - The use of SBRT is considered not medically necessary for definitive treatment of gall bladder cancer.

- The use of SBRT is considered not medically necessary for adjuvant (postoperative) treatment of gall bladder cancer.

- Renal cell carcinoma
  - The use of 3-dimensional conformal radiation therapy (3DCRT), intensity modulated radiation therapy (IMRT), or SBRT is considered not medically necessary in the definitive treatment of kidney cancer.
- Lung cancer
  - For stage I, node-negative stage IIA or T3N0 (T3 based on size) non-small cell lung cancer (NSCLC), the following regimens are considered medically necessary:
    - Definitive external beam radiation therapy to a dose of 60-70 Gy in 30-35 fractions using 3-dimensional conformal radiation therapy (3DCRT)
    - Up to 5 fractions of stereotactic body radiation therapy (SBRT). SBRT, as a complete course of therapy, must be completed in 5 fractions in a single episode of care
  - For stage I or node-negative stage IIA limited-stage small-cell lung cancer (LSSCLC), the following regimens are considered medically necessary:
    - 3D conformal radiation therapy to a dose of 60-70 Gy in 30-35 fractions or 45 Gy delivered twice daily
    - Up to 5 fractions of stereotactic body radiation therapy (SBRT). SBRT, as a complete course of therapy, must be completed in 5 fractions in a single episode of care.
- Oligometastatic cancer
  - Up to 5 fractions of stereotactic body radiotherapy (SBRT) for extra-cranial oligometastases is considered medically necessary in the following clinical situations:
    - For an individual with non-small cell lung cancer who meets all of the following criteria:
      - Has had or will undergo curative treatment of the primary tumor (based on T and N stage)
      - Has 1 to 3 metastases in the synchronous setting
    - For an individual with colorectal cancer who meets all of the following criteria:
      - Has had or will undergo curative treatment of the primary tumor
      - Presents with 1 to 3 metastases in the lung or liver in the synchronous setting
      - For whom surgical resection is not possible
    - For an individual who meets the following criteria:
      - A clinical presentation of 1 to 3 adrenal gland, lung, liver, or bone metastases in the metachronous setting when ALL of the following criteria are met:
        - Histology is non-small cell lung, colorectal, breast, sarcoma, renal cell, melanoma, or prostate
        - Disease free interval of > 1 year from the initial diagnosis
        - Primary tumor received curative therapy and is controlled
        - No previous evidence of metastatic disease (cranial or extracranial)
        - All metastatic lesions present on imaging will be treated concurrently in a single episode of care
      - SBRT used to stimulate the abscopal effect is considered experimental, investigational, or unproven.
    - For an individual with oligoprogression (progression of a limited number of metastatic sites while other metastatic disease sites remain controlled), SBRT is considered not medically necessary.
    - SBRT, as a complete course of therapy, must be completed in 5 fractions in a single episode of care.
- Pancreatic cancer
  - SBRT using up to 5 fractions is considered medically necessary for curative treatment of unresectable/locally advanced cases and as preoperative treatment in borderlines resectable cases.
  - SBRT is considered not medically necessary in the palliative setting, postoperative setting, or for planned neoadjuvant treatment when the primary tumor is otherwise fully resectable.

- Prostate cancer
  - The following treatments are considered medically necessary for treatment of low-risk prostate cancer:
    - Hypofractionation – 20-28 fractions of IMRT in up to 2 phases
    - Up to 5 fractions of SBRT alone (i.e., not as a boost)
  - The following treatments are considered medically necessary for treatment of intermediate-risk prostate cancer:
    - Hypofractionation – 20-28 fractions of IMRT in up to 2 phases
    - Up to 5 fractions of SBRT alone (i.e., not as a boost)
  - The following treatments are considered medically necessary for treatment of high-risk prostate cancer when not treating the pelvic lymph nodes:
    - Hypofractionation – 20-28 fractions of IMRT in up to 2 phases
    - Up to 5 fractions of SBRT alone (i.e., not as a boost)
- Melanoma
  - The use of SBRT to induce the abscopal effect is considered experimental, investigational, or unproven.
- Soft-tissue sarcoma
  - Up to 5 fractions of SBRT is considered medically necessary in the treatment of recurrent soft-tissue sarcoma located within a previously irradiated area.

Regence includes the following in its coverage policy for SBRT[312]:

- SRS and SBRT, also known as SABR, may be considered medically necessary for initial treatment or treatment of recurrence for any of the following indications:
  - Head and neck cancers outside of intracranial, skull base, and orbital sites, when there is documented previous radiation treatment to the planned target volume
  - Hemangioblastoma of the spine
  - Hemangiopericytoma outside of intracranial, skull base, or orbital sites
  - Hepatic tumor (excluding hepatocellular carcinoma; primary or metastatic) as palliative or curative treatment when both of the following are met:
    - Absence or minimal extra hepatic disease; and
    - Karnofsky performance score greater than or equal to 60 or an ECOG score less than or equal to 2
  - Hepatocellular carcinoma (hepatoma) when all of the following criteria are met:
    - 5 or fewer hepatic lesions; and
    - Size of largest lesion is 6 cm diameter or less; and
    - Karnofsky performance score greater than or equal to 60 or an ECOG score less than or equal to 2
  - Lung metastases when both of the following criteria are met:
    - 5 or fewer metastatic lung lesions; and
    - Karnofsky performance score greater than or equal to 60 or an ECOG score less than or equal to 2
  - Non-small cell lung cancer (NSCLC), primary (node negative, tumor stage T1 and T2)
  - Oligometastases when the following criteria are met:
    - 5 or fewer metastatic lesions; and
    - Primary is controlled, stable, or expectation of the same; and
    - Metastases are limited to one to three organs; and
    - Karnofsky performance score greater than or equal to 60 or an ECOG score less than or equal to 2
  - Osteosarcoma, metastatic when all of the following criteria are met:
    - 5 or fewer metastatic lesions; and
    - Karnofsky performance score greater than or equal to 60 or an ECOG score less than or equal to 2

- Pancreatic adenocarcinoma, locally advanced, borderline resectable, inoperable, or local recurrence after resection
- Paraganglioma
- Prostate cancer, very low- to intermediate-risk
- Renal cell cancer, inoperable primary, when a urological surgeon has documented inoperability
- Schwannomas
- Spinal or paraspinal tumors (primary or metastatic)

- SRS and SBRT (also known as SABR) are considered investigational when the first criterion is not met and for all other indications outside of intracranial, skull base, or orbital
- sites, including but not limited to:
  - Tumors, primary, of the cervix, endometrium, esophagus, hemangiomas, large bowel, ovaries, rectum, and small bowel

Clinical Practice Guidelines

Prostate Cancer

Table 1. Excerpted Clinical Practice Recommendations on Stereotactic Body Radiation Therapy for Prostate Cancer

Organization and Year Title Methodological Quality	Recommendations	
American Society for Radiation Oncology and American Urological Association (ASTRO/AUA), 2022 Clinically localized prostate cancer: AUA/ASTRO guideline, part I[281]; part II[282]; and part III[29] Good methodological quality	Clinicians may offer ultrahypofractionated EBRT for patients with low- or intermediate-risk prostate cancer who elect EBRT.	Strong recommendation; evidence level: grade A
	In patients with low- or favorable intermediate-risk prostate cancer electing radiation therapy, clinicians should offer dose-escalated hypofractionated EBRT (moderate or ultra), permanent low-dose rate (LDR) seed implant, or temporary high-dose rate (HDR) prostate implant as equivalent forms of treatment.	Strong recommendation; evidence level: grade B
Prostate Cancer Guidelines Panel, 2022 EAU - EANM - ESTRO - ESUR - ISUP - SIOG guidelines on prostate cancer[283] Good methodological quality	SBRT was discussed in literature review but panel concluded there was not enough evidence to make recommendations on its use.	Available evidence is of low quality; strong recommendations cannot be made.
Australian and New Zealand Faculty of Radiation Oncology Genito-Urinary Group (FROGG), 2018 Radiotherapy for recurrent prostate cancer: 2018 Recommendations of the	3.4. Recurrence limited to pelvic lymph nodes after curative local treatment: SBRT alone to involved node(s) may be considered in selected patients, but these patients should be informed that they are at high risk of relapse which may be harder to treat with curative intent	5, D • Expert opinion without explicit critical appraisal, or based on physiology, bench research or "first principles"

Organization and Year Title Methodological Quality	Recommendations	
Australian and New Zealand Radiation Oncology Genito-Urinary group[284] Poor methodological quality		• Level 5 evidence or troublingly inconsistent or inconclusive studies of any level
	Radiotherapy management of oligometastases: 4.3. Patients should be encouraged to enter clinical trials where available to ascertain potential benefit of SBRT in addition to standard of care systemic therapy	4, D • Case-series (and poor-quality cohort and case-control studies • Level 5 evidence or troublingly inconsistent or inconclusive studies of any level
	5.4. If considering salvage local therapy, options include salvage prostatectomy, brachytherapy, stereotactic radiotherapy, HIFU, cryotherapy and salvage electroporation. Local salvage treatments are associated with significant toxicity and an individualized-treatment approach is recommended. Suitable patients should be considered for clinical trials.	4, C • Case-series (and poor-quality cohort and case-control studies • Level 4 studies or extrapolations from level 2 or 3 studies

Abbreviations. EANM: European Association of Nuclear Medicine; EAU: European Association of Urologists; EBRT: external beam radiation therapy; ESTRO: European SocieTy for Radiotherapy and Oncology; ESUR: European Society of Urogenital Radiotherapy; ISUP: International Society of Urological Pathology; SBRT: stereotactic body radiation therapy; SIOG: International Society of Geriatric Oncology.

Lung Cancer

Table 2. Excerpted Clinical Practice Recommendations on Stereotactic Body Radiation Therapy for Lung Cancer

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
American Society of Clinical Oncology (ASCO), 2021 Radiation therapy for small-cell lung cancer: ASCO guideline endorsement of an ASTRO guideline[285] Good methodological quality	Recommendation 2.1. For patients with stage I or II node-negative LS-SCLC who are medically inoperable, either SBRT or conventional fractionation is recommended. • Ultracentral tumors (ASCO clarifying comment: meaning those with the planning target	Strength of recommendation: strong Quality of evidence: moderate

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
	volume touching or overlapping the proximal bronchial tree, esophagus, or trachea) may be more appropriately treated with conventional fractionation schema.	
Society of Interventional Radiology (SIR), 2021 Society of Interventional Radiology multidisciplinary position statement on percutaneous ablation of non-small cell lung cancer and metastatic disease to the lungs: endorsed by the Canadian Association for Interventional Radiology, the Cardiovascular and Interventional Radiological Society of Europe, and the Society of Interventional Oncology[287] Moderate methodological quality	In patients with stage IA NSCLC, image-guided thermal ablation is a safe and effective treatment with minimal complications and acceptable long-term oncological and survival outcomes that are comparable to SBRT and sublobar resection. Thermal ablation should be considered alongside surgical resection and SBRT in patients who require preservation of lung parenchyma function.	Level C, moderate quality • Nonrandomized studies • Supported by moderate quality evidence for or against recommendation; new research may be able to provide additional context
European Society for Medical Oncology (ESMO), 2020 (update of 2018) Metastatic non-small cell lung cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up[289] and Metastatic Non-Small-Cell Lung Cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up 2020 Update[286] Moderate methodological quality	Stage IV patients with limited synchronous metastases at diagnosis may experience long-term disease-free survival (DFS) following systemic therapy and local consolidative therapy [LCT: high-dose RT including stereotactic ablative body RT (SABR) or surgery]	Level IIIB • Prospective cohort studies • Strong or moderate evidence for efficacy but with a limited clinical benefit, generally recommended
National Institute for Health and Care Excellence (NICE), 2018 Lung cancer: diagnosis and management [NG122][288] Good methodological quality	1.6.5. For people with stage I–IIA (T1a–T2b, N0, M0) NSCLC who decline lobectomy or in whom it is contraindicated, offer radical radiotherapy with stereotactic ablative radiotherapy (SABR) or sublobar resection.	Sublobar resection and SABR [..] not clear which is better.
	1.6.8. For people with stage I–IIA (T1a–T2b, N0, M0) NSCLC who decline surgery or in whom any surgery is contraindicated, offer	SABR provides better survival outcomes [..] people often prefer it

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
	SABR. If SABR is contraindicated, offer either conventional or hyperfractionated radiotherapy.	because it involves fewer hospital visits.
	1.6.9. For eligible people with stage IIIA NSCLC who cannot tolerate or who decline chemoradiotherapy (with or without surgery), consider radical radiotherapy (either conventional or hyperfractionated).	Evidence was not strong enough to recommend conventional radiotherapy over hyperfractionated regimens or vice versa.

Abbreviations. LS-SCLC: limited-stage small-cell lung cancer; NSCLC: non-small cell lung cancer; SBRT: stereotactic body radiation therapy.

Gynecological Cancers

Table 3. Excerpted Clinical Practice Recommendations on Stereotactic Body Radiation Therapy for Gynecologic Cancers

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
European Society of Gynaecological Oncology (ESGO), 2018 European Society of Gynaecological Oncology/European Society for Radiotherapy and Oncology/European Society of Pathology Guidelines for management of patients with cervical cancer[293] Good methodological quality	Pelvic sidewall recurrence after primary surgery • Definitive radiotherapy or chemoradiotherapy followed by a stereotactic ablative boost/image-guided interstitial brachytherapy/particle beam therapy is an emerging option.	Not provided
	Central pelvic or pelvic sidewall recurrence after radiotherapy or chemoradiotherapy • Management of isolated organ metastases (lung, liver, etc.) should be discussed in a multidisciplinary team involved in treatment of specific organ affected by metastasis and should be treated according to preferred method for that organ involving local resection, radiofrequency ablation, interventional brachytherapy, or stereotactic ablative	Not provided

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
	radiotherapy according to size and anatomical position.	
European Society of Gynaecological Oncology (ESGO), 2020 ESGO/ESTRO/ESP guidelines for management of patients with endometrial carcinoma[294] Good methodological quality	Radiotherapy pretreated patients with locoregional recurrence • If surgery is not feasible, radical re-irradiation options include stereotactic body radiotherapy targeting recurrence, permanent seed implants, or proton therapy. In selected cases, limited volume re-irradiation with EBRT and brachytherapy boost may be an option (especially if longer interval from first irradiation).	IV, C • Retrospective cohort studies or case–control studies • Insufficient evidence for efficacy or benefit does not outweigh risk or disadvantages (adverse events, costs, etc.), optional
	Oligometastatic recurrent disease • Treatment options include: surgery, radiation therapy including stereotactic radiotherapy, and local ablating techniques	IV,5 B • Retrospective cohort studies or case–control studies • Insufficient evidence for efficacy or benefit does not outweigh risk or disadvantages (adverse events, costs, etc.), optional

Abbreviations. ESP: European Society of Pathology; ESTRO: European SocieTy for Radiotherapy and Oncology.

Melanoma

Table 4. Excerpted Clinical Practice Recommendations on Stereotactic Body Radiation Therapy for Melanoma

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
European Society for Medical Oncology (ESMO), 2019 Cutaneous melanoma: ESMO clinical practice guidelines for diagnosis, treatment and follow-up Approved by the ESMO Guidelines Committee: February 2002, last update September 2019[295]	Surgical removal or stereotactic irradiation of locoregional recurrence or single distant metastasis should be considered in fit patients, as a therapeutic option, offering potential for long-term disease control.	III, C • Prospective cohort studies • Insufficient evidence for efficacy or benefit does not outweigh risk or disadvantages (adverse events, costs, etc.), optional

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
Moderate methodological quality		

Renal Cancer

Table 5. Excerpted Clinical Practice Recommendations on Stereotactic Body Radiation Therapy for Renal Cancer

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
National Comprehensive Cancer Network (NCCN), 2022 Kidney Cancer, Version 3.2022 Moderate methodological quality	Resection is preferred over locally ablative procedures (e.g., image-guided ablation or SBRT However, these local techniques can be considered for liver or lung oligometastases In patients with a limited number of liver or lung metastases, ablative radiotherapy to the metastatic site can be considered in highly selected cases or in the setting of a clinical trial. Radiotherapy should not be used in the place of surgical resection. Radiotherapy should be delivered in a highly conformal manner. The techniques can include 3D conformal radiation therapy, intensity-modulated radiation therapy (IMRT), or SBRT SBRT may be considered for medically inoperable patients with Stage I kidney cancer (category 2B), with Stage II/III kidney cancer (both category 3)	Not reported
European Association of Urology (EAU), 2022	Local therapy of metastases in metastatic RCC • "Offer stereotactic radiotherapy for clinically	Weak

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
EAU guidelines on renal cell carcinoma[297] Good methodological quality	relevant bone- or brain metastases for local control and symptom relief." Local ablative therapy • "Although early results of [SBRT] are encouraging, more evidence from randomised trials is needed."	
American Urology Association (AUA), 2021 Renal mass and localized renal cancer: evaluation, management, and follow-up: AUA guideline: Part I[296] and Part II[299] Good methodological quality	"Non-extirpative methods, eg, stereotactic-body-radiation-therapy or high-intensity-focused-ultrasound, are still investigational." (Pt 1)	Not applicable
European Society for Medical Oncology (ESMO), 2019 Renal cell carcinoma: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up Approved by ESMO Guidelines Committee: September 2008, last update January 2019. This publication supersedes previously published version—Ann Oncol 2016; 27 (Suppl 5): v58 to v68[298] Moderate methodological quality	Management of advanced/metastatic disease • RT can be used to treat unresectable local or recurrent disease and in patients unsuitable for surgery due to poor PS or unsuitable clinical condition. RT is an alternative if radioablation is not appropriate. Image-guided RT techniques such as VMAT or SBRT are needed to enable a high dose to be delivered.	IV, B • Retrospective cohort studies or case-control studies • Strong or moderate evidence for efficacy but with a limited clinical benefit, generally recommended

Abbreviations. PS: performance status; RCC: renal cell carcinoma; RT: radiation therapy; SBRT: stereotactic body radiotherapy; VMAT: volumetric-modulated arc therapy.

Pancreatic Cancer

Table 6. Excerpted Clinical Practice Recommendations on Stereotactic Body Radiation Therapy for Pancreatic Cancer

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
American Society for Radiation Oncology (ASTRO), 2019 Radiation Therapy for Pancreatic Cancer: Executive Summary of an ASTRO Clinical Practice Guideline[301] Good methodological quality	a. Following surgical resection of pancreatic cancer, adjuvant SBRT is only recommended on a clinical trial or multi-institutional registry.	Strong recommendation Very low quality of evidence; 100% consensus
	b. For patients with borderline resectable pancreatic cancer and select locally advanced pancreatic cancer appropriate for downstaging prior to surgery, a neoadjuvant therapy regimen of systemic chemotherapy followed by multifraction SBRT is conditionally recommended.	Conditional recommendation Low quality of evidence; 77% consensus
	c. For patients with locally advanced pancreatic cancer not appropriate for downstaging to eventual surgery, a definitive therapy regimen of systemic chemotherapy followed by either (1) conventionally fractionated RT with chemotherapy, (2) dose-escalated chemoradiation, or (3) multifraction SBRT without chemotherapy is conditionally recommended.	Conditional recommendation Low quality of evidence; 77% consensus

Abbreviations. RT: radiation therapy; SBRT: stereotactic body radiation therapy.

Liver and Biliary Tract Cancer

Table 7. Excerpted Clinical Practice Recommendations on Stereotactic Body Radiation Therapy for Liver and Biliary Tract Cancer

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
American College of Radiology (ACR), 2022 American College of Radiology ACR appropriateness criteria management of liver cancer[302]	*Note. The recommendations list it as "EBRT" but discussion shows that they mean SBRT.* Hepatocellular cancer • Solitary tumor less than 3 cm, cirrhotic - may be appropriate • Solitary tumor 3 to 5 cm, cirrhotic - may be appropriate	Not provided

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
Good methodological quality	• Multifocal, bilobar disease, at least 1 tumor greater than 5 cm, cirrhotic - may be appropriate • Solitary or multifocal disease with vascular invasion, cirrhotic - may be appropriate Intrahepatic cholangiocarcinoma • Peripheral hepatic lobar cholangiocarcinoma, less than 3 cm; no biliary ductal dilatation, macroscopic vascular invasion, regional lymphadenopathy, or distant metastases - may be appropriate Ductal cholangiocarcinoma • Hilar cholangiocarcinoma, greater than 3 cm with poorly defined margins, vascular invasion, and periportal lymphadenopathy - may be appropriate Metastatic liver disease • Multifocal metastatic neuroendocrine tumor (includes carcinoid tumors as well as islet cell tumors of the pancreas) - may be appropriate • Solitary colorectal liver metastasis - may be appropriate • Multifocal bilobar colorectal carcinoma (liver dominant or isolated) - usually not appropriate	
American Society for Radiation Oncology (ASTRO), 2022 External beam radiation therapy for primary liver cancers: an ASTRO clinical practice guideline[303] Good methodological quality	*Note: SBRT is described as ultrahypofractionated EBRT.* a. For patients with HCC who are potential candidates for OLT, ultra- or moderately hypofractionated EBRT is conditionally recommended as a bridge to transplant or as a downstaging intervention.	Strength of recommendation: conditional Quality of evidence: low
	b. For patients with liver-confined HCC, for whom EBRT is recommended, dose-escalated ultra- or moderately hypofractionated EBRT is recommended, with choice of regimen based on tumor location, underlying liver function, and available technology.	Strength of recommendation: strong Quality of evidence: moderate

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
	c. For patients with unresectable IHC receiving EBRT, dose-escalated ultra- or moderately hypofractionated EBRT is conditionally recommended with fractionation based on tumor location, underlying liver function, and available technology. Implementation remark: Concurrent systemic therapy should not be used with ultrahypofractionated EBRT.	Strength of recommendation: conditional Quality of evidence: low
European Society for Medical Oncology (ESMO), 2022 Biliary tract cancer: ESMO clinical practice guideline for diagnosis, treatment and follow-up[304] Moderate methodological quality	SBRT can be considered for patients with IHC in case of contraindication to surgery for liver-limited disease in palliative setting.	III, C • Prospective cohort studies • Insufficient evidence for efficacy or benefit does not outweigh the risk or the disadvantages (adverse events, costs, etc.), optional
European Society for Medical Oncology (ESMO), 2018 Hepatocellular carcinoma: ESMO clinical practice guidelines for diagnosis, treatment and follow-up[305] Moderate methodological quality	High conformal HDR radioablation and SBRT may be considered as alternatives for ablation of tumors with a high risk of local failure after thermal ablation due to location.	III, C • Prospective cohort studies • Insufficient evidence for efficacy or benefit does not outweigh risk or disadvantages (adverse events, costs, etc.), optional

Abbreviations. EBRT: external beam radiation therapy; HCC: hepatocellular carcinoma; HDR: high dose rate; IHC: intrahepatic cholangiocarcinoma; OLT: orthotopic liver transplantation; SBRT: stereotactic body radiation therapy.

Bone Cancers

Table 8. Excerpted Clinical Practice Recommendations on Stereotactic Body Radiation Therapy for Bone Cancer

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
European Society for Medical Oncology (ESMO), 2021 Bone sarcomas: ESMO-EURACAN-GENTURIS-ERN PaedCan clinical practice guideline for diagnosis, treatment, and follow-up[306] Moderate methodological quality	a. "For lung metastases, stereotactic RT, radiofrequency ablation (RFA) or cryotherapy might be used as alternative options in patients unfit for surgery [IV, B]. Some groups also consider RFA and stereotactic RT as potentially alternative local treatment options for bone metastases." *Note. Lung metastases from primary bone cancer.*	IV, B • Retrospective cohort studies or case–control studies • Strong or moderate evidence for efficacy but with a limited clinical benefit, generally recommended
	b. "For oligometastatic disease, surgery, RFA, cryotherapy or stereotactic RT can be considered in selected cases."	V, B • Studies without control group, case reports, expert opinions • Strong or moderate evidence for efficacy but with a limited clinical benefit, generally recommended
	c. "RFA and stereotactic RT are potential alternative local treatment options in patients unfit for surgery and for small lung or bone metastases."	V, B • Studies without control group, case reports, expert opinions • Strong or moderate evidence for efficacy but with a limited clinical benefit, generally recommended
Spanish Society of Radiation Oncology (SEOR), 2022 SEOR SBRT-SG stereotactic body radiation therapy consensus guidelines for nonspine bone metastasis[307] Poor methodological quality	"..it is not possible to clearly differentiate between patients who are candidates for SBRT and those who should undergo prophylactic surgery." "The initial evaluation of patients with NSBM who are potential candidates for SBRT must take into account the performance status of patients" "The use of SBRT in polymetastatic patients in whom not all lesions are susceptible to radical local treatment (SBRT or surgery) has been published but is not the standard of care."	Not provided

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
	"The authors recommended a single fraction as the first treatment option because this scheme requires fewer hospital resources and a shorter hospital stay, an important benefit, especially in the context of the current pandemic. Notwithstanding that recommendation, the most widely accepted fractionation schedules to ensure a BED ≥ 60 Gy are a single fraction of 20–24 Gy, three fractions of 10 Gy each, or five fractions of 7–10 Gy." "Dose de-escalation—defined as more fractions with a lower dose per fraction—should be performed if the lesion has previously been treated with SBRT or EBRT (provided that > 3 months have elapsed between treatments), or if the lesions involve weight-bearing bones, or in patients with moderate-severe (≥ 30%) cortical erosion." "Dose escalation should be considered in metastases with a radiation-resistant histology (e.g., colon, kidney, melanoma, and sarcoma) or if bulky mass or extraosseous involvement is present."	

Abbreviations. BED: biologically equivalent dose; EBRT: external beam radiation therapy; EURACAN: European Reference Network for rare adult solid cancers; GENTURIS ERN: European Reference Network for all patients with one of the rare genetic tumor risk syndromes; NSBM: nonspine bone metastases; RT: radiation therapy.

Testicular Cancer

Table 9. Excerpted Clinical Practice Recommendations on Stereotactic Body Radiation Therapy for Testicular Cancer

Organization and Year Title Methodological Quality	Recommendations	Strength of Recommendation
European Society for Medical Oncology (ESMO), 2022 Testicular seminoma and non-seminoma: ESMO-EURACAN clinical practice guideline for diagnosis, treatment and follow-up[308]	Salvage treatment • "Principally, all ablative therapies, including stereotactic RT and radiofrequency ablation, should be considered within a multidisciplinary approach with an expert centre."	Not provided

Moderate methodological quality		

Abbreviations. EURACAN: European Reference Network for rare adult solid cancers; RT: radiation therapy.

Next step: proposed findings and decision and public comment

At the next public meeting the committee will review the proposed findings and decision and consider any public comments as appropriate prior to a vote for final adoption of the determination.

1) Based on public comment was evidence overlooked in the process that should be considered?
2) Does the proposed findings and decision document clearly convey the intended coverage determination based on review and consideration of the evidence?

Next step: final determination
Following review of the proposed findings and decision document and public comments:

Final vote

Does the committee approve the Findings and Decisions document with any changes noted in discussion?

If yes, the process is concluded.

If no, or an unclear (i.e., tie) outcome chair will lead discussion to determine next steps.

Washington State Health Care Authority

Final Key Questions and Background

Use of Stereotactic Body Radiation Therapy

Background

Technology of Interest

Radiation therapy is a cancer treatment that uses high-energy X-ray or other particles to destroy cancer cells[1]. A radiation therapy regimen, or schedule, usually consists of a specific number of treatments given over a set period, and can be used to treat different types of cancer.[1] Radiation therapy can also be used in combination with other cancer treatments, such as chemotherapy or surgery.[1]

The most common type of radiation therapy is external-beam radiation therapy (EBRT), which delivers radiation from outside the body.[1] The different types of external-beam radiation therapy are[1]:

- 3-dimensional conformal radiation therapy (3D-CRT)
- Intensity modulated radiation therapy (IMRT)
- Proton beam therapy
- Image-guided radiation therapy (IGRT
- Stereotactic body radiation therapy (SBRT)

SBRT is defined as extracranial stereotactic ablative treatment delivery (which can include the spine) typically delivered in 1 to 5 fractions and is also referred to as stereotactic ablative radiotherapy (SABR).[2] SBRT can be used for a variety of clinical indications as primary treatment for selected early-stage cancers, as treatment for discrete tumors in patients with oligometastatic disease, for selected benign neoplasms in or near the central nervous system (CNS), or in recurrent cancer within previously irradiated regions.[2]

Other radiation-based therapies include implanted internal radiation therapy (or brachytherapy), intraoperative radiation therapy (IORT), systemic radiation therapy, radioimmunotherapy, and may also involve the use of radiosensitizers or radioprotectors.[1]

Clinical Need and Target Populations

In 2019, a total of 1,752,735 new invasive cancer cases were reported in the US: 863,830 among females and 888,905 among males.[3] For all cancers combined, the incidence rate was 439 per 100,000 standard population overall.[3] While cancer affects people of all ages, races, ethnicities, and sexes, it does not affect all groups equally.[3] Differences in genetics, healthy choices, environmental exposures, and other factors can lead to differences in risk among groups of people.[3] For most cancers, increasing age is the most important risk factor, with around 58% of cancers occurring in adults aged 65 years or older.[3]

Policy Context

The use of SBRT for various cancers is increasing in the US[4-6]; however, its effectiveness and safety in routine clinical practice for most cancers are unclear. This topic was originally selected

for the 2012 review because of medium-level concerns about the safety and efficacy of CMRA and high-level concern about costs. This topic was selected for re-review based on new evidence that could prompt potential coverage policy changes.

In 2012 the Washington State HTCC commissioned an evidence review on the effectiveness of stereotactic radiosurgery (SRS) and SBRT for treating various cancers.[7] On March 22, 2013, using that evidence review to guide decision making, the committee adopted the following coverage determination[8]:

- SRS for central nervous system (CNS) primary and metastatic tumors is a covered benefit for adults and children when the following criteria are met:
  - Patient functional status score (i.e., Karnofsky score) is greater than or equal to 50; *and*
  - Evaluation includes multidisciplinary team analysis (e.g., tumor board), including surgical input.
- SBRT is covered for adults and children for the following conditions when the following criteria are met:
  - For cancers of spine/paraspinal structures; *or*
  - For inoperable non–small cell lung cancer (NSCLC), stage 1; *and*
  - Evaluation includes multidisciplinary team analysis, including surgical input.
- All other indications are noncovered.

The objective of the health technology assessment (HTA) is to evaluate the effectiveness, safety, and cost-effectiveness of SBRT in adults and children with cancers not currently covered by the 2012 coverage decision (CNS and a subset of lung cancers). This evidence review will help inform Washington's independent Health Technology Clinical Committee as the committee determines coverage regarding the use of SBRT in adults and children with cancers not currently covered.

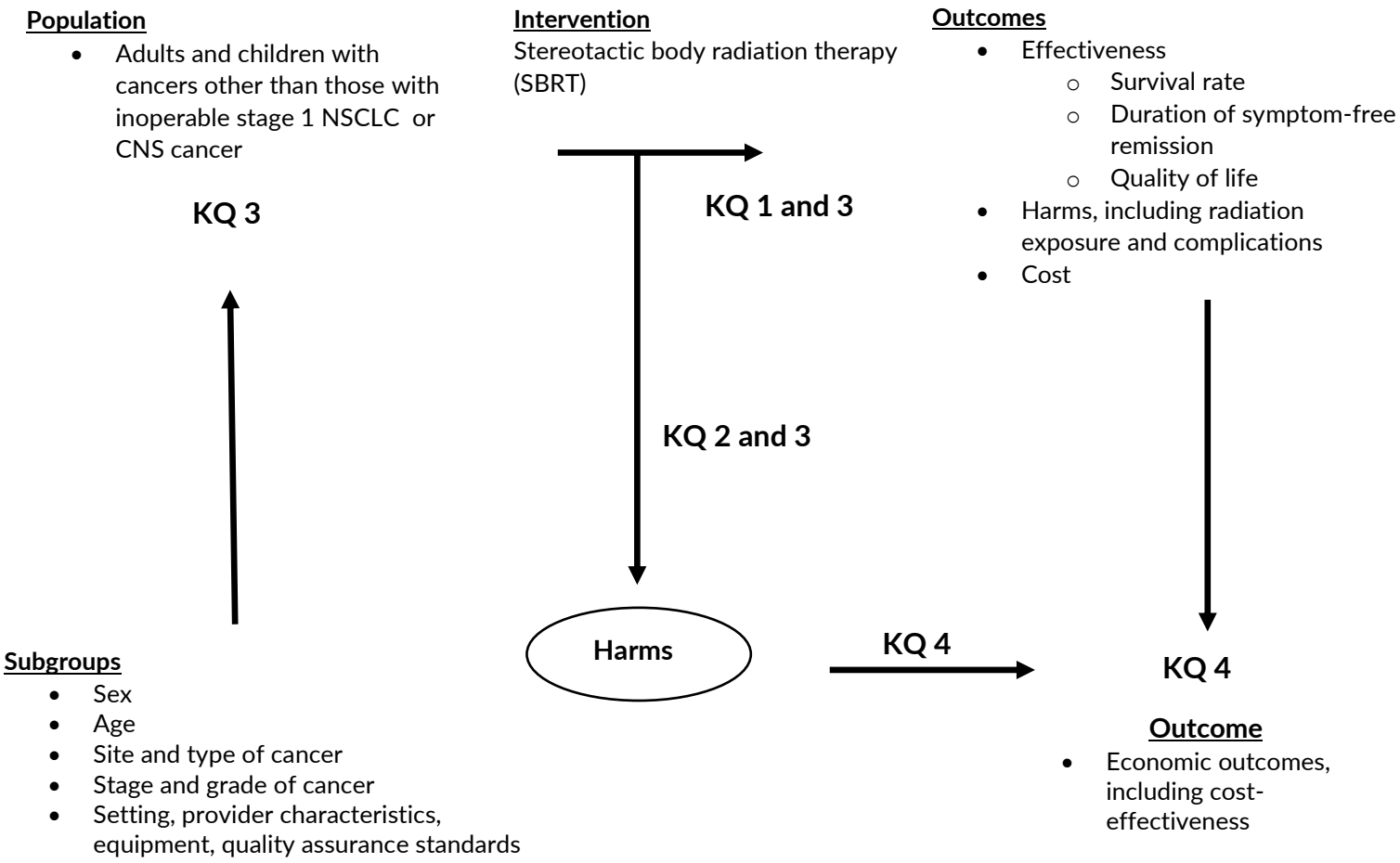
Key Questions

KQ1. What is the evidence of effectiveness for SBRT for patients with cancers not currently covered (CNS cancers and inoperable stage 1 NSCLC)?
KQ2. What are the harms of SBRT in patients with included cancers?
KQ3. What is the evidence that SBRT has differential efficacy or harms in subpopulations, including those defined by:
  a. Sex
  b. Age
  c. Site and type of cancer
  d. Stage and grade of cancer
  e. Setting, provider characteristics, equipment, quality assurance standards and procedures
KQ4. What is the evidence of cost and cost-effectiveness of SBRT?

Washington State Health Care Authority

Analytic Framework

Figure 1. Analytic Framework



Washington State Health Care Authority

Detailed Inclusion and Exclusion Criteria

Study Component	Inclusion	Exclusion
Populations	• Adults and children with non-CNS and non-NSCLC (inoperable, stage 1) malignancies where treatment by radiation therapy is appropriate	• Studies in people with noncancer conditions (e.g., trigeminal neuralgia)
Interventions	• SBRT, with devices such as Gamma Knife, CyberKnife, TomoTherapy, delivered in 10 or fewer fractions	• Treatments delivered in 11 or more fractions • Interventions used for treatment planning or treatment delivery assessment only
Comparators	• Conventional (conformal) external beam radiation therapy (EBRT) • Other forms of radiation (e.g., brachytherapy) • Chemotherapy • Surgery • No treatment	• Comparators other than those stated

Outcomes	• Effectiveness
	  ○ Survival rate
	  ○ Duration of symptom-free remission
	  ○ Quality of life
	• Harms, including radiation exposure and complications
	• Cost
	• Cost-effectiveness
		• Studies that do not report outcomes of interest
		• Data for treatment planning (e.g., dosing) or treatment delivery (e.g., accuracy)
		• Economic outcomes from studies performed in non-US countries
		• Economic outcomes from studies performed in the US that were published more than 5 years ago

Timing	• Any point in the treatment pathway	• None stated
Setting	• Any outpatient or inpatient clinical setting in countries categorized as very high on the UN Human Development Index	• Emergency use settings • Nonclinical settings (e.g., studies in healthy volunteers, animal models of disease) • Countries categorized other than very high on the UN Human Development Index

Study Component	Inclusion	Exclusion

Study Design	• For KQ1, KQ2, and KQ3
	  ○ Comparative study designs (prospective, retrospective, and randomized or controlled clinical trials)
	• For KQ2
	  ○ Comparative study designs
	  ○ Noncomparative study designs (≥ 100 participants)
	• For KQ4
	  ○ Comparative cost data and relevant economic evaluations
	  ○ Cost-effectiveness analyses
	  ○ Economic simulation modeling studies
		• Abstracts, conference proceedings, posters, editorials, letters
		• Studies without a comparator (unless for harms only)
		• Proof-of-principle studies (e.g., technology development or technique modification)
		• Studies without extractable data

Sample Size	• Minimum sample size of 50 participants for comparative study designs • Minimum sample size of 100 participants for noncomparative study designs	• Studies that do not meet the minimum sample size
Publication	• Published, peer-reviewed, English-language articles	• Studies reported only as abstracts that do not allow study characteristics to be determined • Studies that cannot be located • Duplicate publications of the same study that do not report different outcomes or follow-up times, or single site reports from published multicenter studies • Studies published in languages other than English

Abbreviations. CNS: central nervous system; KQ: key question; NSCLC: non–small cell lung cancer; SBRT: stereotactic body radiation therapy; UN: United Nations.

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