

Section 1: Search terms and search strategy

a) PubMed

Query: ((deep learning) OR (neural network)) OR (artificial intelligence) OR (machine learning)) AND ((cancer) OR (tumor)) AND (metastasis)

b) Web of Science

#3 AND #2 AND #1

Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC

Timespan=1997 to 2020

1. TS = (“deep learning” OR “neural network” OR “artificial intelligence” OR “machine learning”)

Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC

Timespan=1997 to 2020

2. TS = (“cancer” OR “tumor”)

Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC

Timespan=1997 to 2020

3. TS = metastasis

Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC

Timespan=1997 to 2020

Section 2: Contingency tables included in the meta-analysis (123 tables from 34 studies)

Study	Year	Type of metastasis	Primary tumor	Image type	External validation	Algorithm	Total number	TP	FP	FN	TN	Sensitivity	Specificity	AUROC
Li-Qiang Zhou	2020	LNM	Breast cancer	US	NO	DL	97	40	10	9	38	0.82	0.79	0.9
Li-Qiang Zhou	2020	LNM	Breast cancer	US	NO	DL	97	39	7	10	41	0.8	0.85	0.89
Li-Qiang Zhou	2020	LNM	Breast cancer	US	NO	DL	97	38	10	11	38	0.78	0.79	0.87
Li-Qiang Zhou	2020	LNM	Breast cancer	US	YES	DL	81	37	10	6	28	0.85	0.73	0.89
Li-Qiang Zhou	2020	LNM	Breast cancer	US	YES	DL	81	34	9	9	29	0.78	0.75	0.88
Li-Qiang Zhou	2020	LNM	Breast cancer	US	YES	DL	81	31	10	12	28	0.73	0.73	0.86
Bettina Baessler	2019	LNM	Others	CT	NO	ML	23	14	0	1	8	0.93	1	
Bettina Baessler	2019	LNM	Others	CT	NO	ML	61	22	10	3	26	0.88	0.76	
Xiaojun Yang	2019	LNM	Breast cancer	CT	NO	DL	164	52	42	11	59	0.825	0.584	0.817
David Coronado0Gutierrez	2019	LNM	Breast cancer	US	NO	DL	118	45	8	8	57	0.849	0.877	0.937
David Coronado0Gutierrez	2019	LNM	Breast cancer	US	NO	DL	77	47	4	6	20	0.887	0.833	0.919
Jeong Hoon Lee	2019	LNM	HNC	CT	NO	DL	104	47	5	5	47	0.904	0.904	0.953
Jeong Hoon Lee	2019	LNM	HNC	CT	NO	DL	104	46	5	6	47	0.885	0.904	0.952
Jeong Hoon Lee	2019	LNM	HNC	CT	NO	DL	104	36	1	16	51	0.692	0.973	0.943
Jeong Hoon Lee	2019	LNM	HNC	CT	NO	DL	104	45	4	7	48	0.865	0.918	0.942
Jeong Hoon Lee	2019	LNM	HNC	CT	NO	DL	104	36	4	16	48	0.692	0.923	0.936
Jeong Hoon Lee	2019	LNM	HNC	CT	NO	DL	104	42	1	10	51	0.808	0.977	0.92
Jeong Hoon Lee	2019	LNM	HNC	CT	NO	DL	104	44	3	8	49	0.846	0.936	0.918
Jeong Hoon Lee	2019	LNM	HNC	CT	NO	DL	104	45	9	7	43	0.865	0.833	0.909
Chuangming Li	2019	LNM	Breast cancer	MRI	NO	ML	13	5	0	2	6	0.71	1	0.83

Chuangming Li	2019	LNM	Breast cancer	MRI	NO	ML	13	6	1	1	5	0.86	0.83	0.83
Chuangming Li	2019	LNM	Breast cancer	MRI	NO	ML	13	5	1	2	5	0.71	0.83	0.88
Yige Peng	2019	DM	Others	PET-CT	NO	DL	48	22	5	2	19	0.92	0.7917	0.8542
Qiuxia Feng MD	2019	LNM	Others	CT	NO	ML	490	203	67	76	144	0.726	0.681	0.764
Samir D. Mehta	2019	DM	NR	Others	NO	ML	200	35	0	10	155	0.78	1	0.889
Samir D. Mehta	2019	DM	NR	Others	NO	ML	200	15	5	30	150	0.33	0.97	0.651
Yoshiko Arijji	2019	LNM	HNC	CT	NO	DL	441	96	60	31	254	0.754	0.81	0.8
Yu Li	2019	DM	Others	CT	NO	ML	48	19	3	5	21	0.7886	0.8648	0.85
Zhiguo Zhou	2019	LNM	HNC	PET	NO	DL	165	34	18	5	108	0.87	0.86	0.94
Zhiguo Zhou	2019	LNM	HNC	PET	NO	DL	165	33	19	6	107	0.85	0.85	0.92
Zhiguo Zhou	2019	LNM	HNC	PET	NO	DL	165	37	10	2	116	0.95	0.92	0.98
Zhiguo Zhou	2019	LNM	HNC	CT	NO	DL	165	34	20	5	106	0.87	0.84	0.95
Zhiguo Zhou	2019	LNM	HNC	CT	NO	DL	165	32	21	7	105	0.82	0.83	0.88
Zhiguo Zhou	2019	LNM	HNC	CT	NO	DL	165	35	13	4	113	0.9	0.9	0.97
Zhiguo Zhou	2019	LNM	HNC	PET-CT	NO	DL	165	33	14	6	112	0.85	0.89	0.96
Zhiguo Zhou	2019	LNM	HNC	PET-CT	NO	DL	165	27	6	12	120	0.69	0.95	0.95
Zhiguo Zhou	2019	LNM	HNC	PET-CT	NO	DL	165	37	9	2	117	0.95	0.93	0.99
Fang Hou	2019	LNM	NR	CT	NO	ML	259	22	8	3	226	0.88	0.97	
Jiaxiu Luo	2018	LNM	Breast cancer	MRI	NO	ML	172	44	20	30	78	0.6	0.8	0.798
Jiaxiu Luo	2018	LNM	Breast cancer	MRI	NO	ML	172	59	16	15	82	0.8	0.833	0.828
Jiaxiu Luo	2018	LNM	Breast cancer	MRI	NO	ML	172	44	26	30	72	0.6	0.733	0.767
Jiaxiu Luo	2018	LNM	Breast cancer	MRI	NO	ML	172	48	20	26	78	0.65	0.8	0.788
Jiaxiu Luo	2018	LNM	Breast cancer	MRI	NO	ML	172	41	26	33	72	0.55	0.733	0.737
Jiaxiu Luo	2018	LNM	Breast cancer	MRI	NO	ML	172	44	23	30	75	0.6	0.767	0.777
Jiaxiu Luo	2018	LNM	Breast cancer	MRI	NO	ML	172	56	13	18	85	0.75	0.867	0.823

Jiaxiu Luo	2018	LNM	Breast cancer	MRI	NO	ML	172	64	16	10	82	0.867	0.833	0.852
B.H. Kann	2018	LNM	HNC	CT	NO	DL	653	319	35	61	238	0.84	0.87	0.91
Jeong Hoon Lee	2018	LNM	HNC	US	NO	DL	63	31	0	2	30	0.93	1	
Jeong Hoon Lee	2018	LNM	HNC	US	NO	DL	200	89	23	11	77	0.89	0.77	
José Raniery Ferreira Junior	2018	LNM	Others	CT	NO	ML	16	6	2	3	5	0.67	0.71	0.75
José Raniery Ferreira Junior	2018	DM	Others	CT	NO	ML	16	4	6	1	5	0.8	0.46	0.71
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	92	14	28	106	0.7708	0.8837	0.9148
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	106	59	14	61	0.8805	0.5042	0.7997
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	92	14	28	106	0.7708	0.8837	0.9148
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	93	14	27	106	0.7782	0.8848	0.8997
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	98	14	22	106	0.8156	0.8859	0.9165
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	88	21	32	99	0.7335	0.8266	0.8624
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	102	19	18	101	0.8491	0.8406	0.9137
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	99	18	21	102	0.8289	0.8512	0.9031
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	103	19	17	101	0.8565	0.8445	0.9143
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	85	22	35	98	0.7073	0.8158	0.8466
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	100	19	20	101	0.8295	0.8456	0.9097
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	101	16	19	104	0.8408	0.8662	0.9044
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	91	18	29	102	0.7565	0.8538	0.874
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	64	35	56	85	0.5326	0.7102	0.6581
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	62	33	58	87	0.5189	0.7287	0.6458
Wang, H	2017	LNM	Others	PET-CT	NO	ML	240	91	29	29	91	0.7562	0.7591	0.8117
Wang, H	2017	LNM	Others	PET-CT	NO	DL	240	100	15	20	105	0.8353	0.8775	0.9086

Yan Zhong	2018	LNM	Others	CT	NO	ML	492	74	33	4	381	0.948	0.92	0.972
Mitsuru Koizumi	2017	DM	Others	BS	YES	ML	265	102	17	22	84	0.82	0.83	0.888
Tuan D. Pham	2017	LNM	Others	US	NO	ML	271	78	23	55	115	0.59	0.83	0.76
Tuan D. Pham	2017	LNM	Others	US	NO	ML	271	97	30	36	108	0.73	0.78	0.81
Tuan D. Pham	2017	LNM	Others	US	NO	ML	271	73	26	60	112	0.55	0.81	0.72
Tuan D. Pham	2017	LNM	Others	US	NO	ML	271	96	47	37	91	0.72	0.66	0.72
Tuan D. Pham	2017	LNM	Others	US	NO	ML	271	104	33	29	105	0.78	0.76	0.82
Tuan D. Pham	2017	LNM	Others	US	NO	ML	271	102	28	31	110	0.77	0.8	0.85
Tuan D. Pham	2017	LNM	Others	US	NO	ML	271	84	7	49	131	0.63	0.95	0.86
Tuan D. Pham	2017	LNM	Others	US	NO	ML	271	97	19	36	119	0.73	0.86	0.86
Tuan D. Pham	2017	LNM	Others	US	NO	ML	271	100	14	33	124	0.75	0.9	0.89
Qi Zhang	2017	LNM	Breast cancer	US	NO	ML	161	79	17	13	52	0.859	0.754	0.875
Qi Zhang	2017	LNM	Breast cancer	US	NO	ML	161	63	9	29	60	0.685	0.87	0.794
Qi Zhang	2017	LNM	Breast cancer	US	NO	ML	161	78	9	14	60	0.848	0.87	0.895
Qi Zhang	2017	LNM	Breast cancer	US	NO	ML	161	66	8	26	61	0.717	0.884	
Qi Zhang	2017	LNM	Breast cancer	US	NO	ML	161	63	11	29	58	0.685	0.841	
Qi Zhang	2017	LNM	Breast cancer	US	NO	ML	161	77	10	15	59	0.837	0.855	
Yu-wen Wang	2016	LNM	HNC	MRI	NO	ML	410	173	10	38	189	0.822	0.952	
Aneta Chmielewski	2015	LNM	Breast cancer	US	NO	ML	105	21	8	2	73	0.9	0.9	0.95
Mitsuru Koizumi	2015	DM	Others	BS	YES	ML	426	128	53	24	221	0.841	0.807	
Osamu Tokuda	2014	DM	Others	BS	YES	ML	568	99	100	5	364	0.952	0.784	
Osamu Tokuda	2014	DM	Breast cancer	BS	YES	ML	872	35	267	7	563	0.833	0.678	
Osamu Tokuda	2014	DM	Others	BS	YES	ML	1224	50	333	6	835	0.893	0.715	
Osamu Tokuda	2014	DM	Others	BS	YES	ML	584	33	199	0	352	1	0.639	
Zhi-Guo Zhou	2013	LNM	Others	CT	NO	ML	175	120	8	14	33	0.8951	0.8	0.829

Zhi-Guo Zhou	2013	LNM	Others	CT	NO	ML	175	113	15	21	26	0.8453	0.6429	0.791
Zhi-Guo Zhou	2013	LNM	Others	CT	NO	ML	175	117	13	17	28	0.8723	0.6765	0.78
Zhi-Guo Zhou	2013	LNM	Others	CT	NO	ML	175	103	16	31	25	0.7657	0.6036	0.688
Zhi-Guo Zhou	2013	LNM	Others	CT	NO	ML	175	115	13	19	28	0.8611	0.6774	0.781
Zhi-Guo Zhou	2013	LNM	Others	CT	NO	ML	175	116	14	18	27	0.8622	0.6667	0.782
Zhi-Guo Zhou	2013	LNM	Others	CT	NO	ML	175	116	16	18	25	0.8633	0.6111	0.769
Zhi-Guo Zhou	2013	LNM	Others	CT	NO	ML	175	115	14	19	27	0.8552	0.6667	0.793
Seungwook Yang	2013	DM	NR	MRI	NO	ML	496	43	8	10	435	0.811	0.982	0.9355
Seungwook Yang	2013	DM	NR	MRI	NO	ML	5841	16	2	37	5786	0.302	0.9997	0.6508
Xiao-Peng Zhang	2011	LNM	Others	CT	NO	ML	175	119	9	15	32	0.89	0.79	0.88
May Sadik	2008	DM	Breast/prostate cancer	BS	NO	ML	59	19	4	2	34	0.9	0.89	
Junhua Zhang	2008	LNM	NR	US	NO	ML	210	96	15	18	81	0.84	0.84	
Rie Tagaya	2008	LNM	Others	US	NO	ML	82	55	11	5	11	0.924	0.52	
Rie Tagaya	2008	LNM	Others	US	NO	ML	82	56	8	4	14	0.939	0.64	
Rie Tagaya	2008	LNM	Others	US	NO	ML	82	55	5	5	17	0.924	0.76	
Rie Tagaya	2008	LNM	Others	US	NO	ML	82	59	8	1	14	0.985	0.64	
Rie Tagaya	2008	LNM	Others	US	NO	ML	82	51	6	9	16	0.849	0.72	
Rie Tagaya	2008	LNM	Others	US	NO	ML	82	51	4	9	18	0.849	0.84	
Rie Tagaya	2008	LNM	Others	US	NO	ML	82	52	11	8	11	0.864	0.48	
Rie Tagaya	2008	LNM	Others	US	NO	ML	82	55	6	5	11	0.909	0.72	
Rie Tagaya	2008	LNM	Others	US	NO	ML	82	56	6	4	16	0.934	0.72	
Rie Tagaya	2008	LNM	Others	US	NO	ML	82	59	6	1	16	0.985	0.72	
Ali Aslantas	2016	DM	Others	BS	NO	ML	60	37	3	2	18	0.9487	0.8571	
Ali Aslantas	2016	DM	Others	BS	NO	ML	130	94	6	2	28	0.9792	0.8235	

Yoshiko Arij	2019	LNM	HNC	CT	NO	DL	143	24	9	9	101	0.714	0.914	
Yoshiko Arij	2019	LNM	HNC	CT	NO	DL	143	24	15	9	95	0.714	0.867	
Yoshiko Arij	2019	LNM	HNC	CT	NO	DL	143	23	4	10	106	0.686	0.962	
Yoshiko Arij	2019	LNM	HNC	CT	NO	DL	143	20	14	13	96	0.6	0.876	
Yoshiko Arij	2019	LNM	HNC	CT	NO	DL	143	21	15	12	95	0.629	0.867	
Yoshiko Arij	2019	LNM	HNC	CT	NO	DL	143	22	11	11	99	0.669	0.897	

- Abbreviation: NR=not reported. LNM= Lymph node metastasis. DM= distant metastasis. US= ultrasound. CT= computed tomography. MRI= magnetic resonance imaging. BS=bone scintigraphy. HNC= head and neck cancer. DL= Deep learning. ML=Machine learning.