MRI History by the Numbers





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Motivation

The year 2023 – five years from now - will mark the 50th anniversary of Lauterbur's landmark "Zeugmatography" publication describing MR spatial encoding using gradient fields, one of the seminal concepts for MRI as routinely used today. This report is intended to: (1) help capture the arc of history of the first half-century of MRI, to provide context and general knowledge, especially for those whose direct memories start well after the baseline and early waves of the development of MRI; and (2) to inspire feedback about what historical information and formats are of interest to contemporary audiences, to inform what type of "scrapbook" material to collect and curate, for 50-year Anniversary festivities.

Why Numbers?

When you can measure what you are speaking about, and express it in numbers, you know something about it; when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind.

> William Thomson, 1st Baron Kelvin, 1824-1907 Mathematical Physicist & Engineer Creator & Calibrator of the absolute scale of temperature



NYU Langone

MEDICAL CENTER

Methods & Results

The scope and content of the data were chosen as being insightful to the evolution of whole-body diagnostic MRI to its current state. Focus was on initiatives during "Early Days," and ongoing enabling and limiting factors. Data was taken from old and recent publications, and the personal library and memory of the first author. Numbers were compiled into a spreadsheet, and formatted into tables and graphs, as shown below.

Composite Q Manlesta	Number of sites with operational "home-built" (academic) WB scanners	1977 2	1978 2	1979 3	1980 3	1981	1982	1983	1984	1985	1986	1988	1995	1998	2002	2003	2005	2008	2010	2013	2015	2018
Community & Markets:	Number of commercial scanner manufacturers (with at least WB prototype operational)	0	1	2	5	7	9															
Builders & Users	Number of manufacturers with FDA cleared scanners	0	0	0	0	0	0	0	4	6	8			~				~27.000				~18
	Installed Base, commercial WB scanners						~200	~600							15,000			6407	6754	6120	6715	7120
	ANNUAL SIVIRIVI-SIVIR-ISIVIRIVI MEELING, ALLENUEES						300	600									5008 5129	5902	6190	6120	7010	7139
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		Firs	st cohor	ts throu	ıgh US F	DA (Fo	od and	Drug A	dministr	ation) P	PMA (Pr	e-Marke	et Appro	val)								ESMRMB
		Year				1984				1985			1986			A	ANT RALLES	Charles Mark			ISIVIKIVI MAGNETIC RESONANCE IN MEDICINE WWW.ismrm.org	www.esmrmb.or
		anner manuj model na	facturer, D me	iasonics ⁻ Mt/S T	Technicare Teslacon (I)	Pick NMR 1	er F 1000 Bet	Fonar ta 3000	Siemens Magnetorr	General Sig	Electric na (?	Philips Gyroscan S5, ?R5, ?S:	Thc 15)	ompson CG gniscan 500	GR 00							
		Comp EM r	Figure 10Chronol	logical Development of <u>5 1976 1977 1978</u> D E D	the NMR Imaging Devic <u>1979</u> <u>1980</u> <u>1981</u> C.w E	ce Industry' 1982 1983 1984 C M	<u>1985</u>		Table 7.—The	NMR Imaging	Device Indus	ry: Market Sha	re as Reflected								JOINT A ISM 16- SMRT 27*/	NNUAL MEETIN RM-ESMRMB -21 June 2018 Annual Meeting 15-18 June 2018
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	1981	Early R&D we Thin staat 8 & D Inc. purchased * Formed in Ap NMR imaging since 1976	ock in phosphorous spectroscopy bega began as U n iversity of Cai fem ta.S. The nghistic call patentable NMR te ril 1981 after G EC of England acquire R&D in 1977 In October 1981, Picka	an in 1978, but firm corporate common san Francisco (UCSF) project with o cut chology developed under the UCSI d the Picker Corp and merged I with r International purchased all NMR imu	international ended did not begrouth 1 internation BMR imaging was not m itside funding. In 1976, the Pfizer Corp 5-Pfizer agreement h GEC Medical and Cambridge Medical haging technology that had been dev	Technologui traition of Techn I care is ade until 1980 • began funding the work I n 1981, I al Instruments G EC of En gl and welcped Independently by EM I of	in 1979 Diasonics had begun of England	SOURCE	ES Interviews with ma ment Sales Close In	nufacturers, Boteler, On \$4 Billion Mark, *	1983 (20), American Diag. Imag. 5(1 1):55	Hospital Association, 198 -61, November 1983	33 (6), and "Imaging Ec	quip-		ISMRI	ЛLon	don 1	986			
Aberdeen ~1979 UCSF ~197	79															some	Techn	nicare j	folk			

		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1988	1995	1998	2002	2003	2005	2008	2010	2013	2015	2018
	Bo, highest technically proven, >= 80cm warm bore (Tesla)						1.9	1.9	1.9	1.9		4	4	8		9.4	9.4	9.4	9.4	9.4	10.5	10.5
	Bo, max allowed for IEC 1st controlled mode (Tesla)*								4	4		4	4	4		4	4	4	4	4	8	8
lechnology:	Bo, max allowed for IEC normal mode (Tesla)*								2	2		2	2	2		2	2	2	3	3	3	3
	Bo, prevailing purchase choice, (Tesla)*							0.35	0.35	0.5		1.5	1.5	1.5		1.5	1.5	1.5	1.5	1.5	1.5	1.5
Fields and Channels	Patient bore diameter, highest available (cm)*							60	60	60		60	60	60		60	70	70	70	70	70	70
	Grad strength, highest avail able (mT/m)*							3	6	6			15				25			_	80	100



		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1988	1995	1998	2002	2003	2005	2008	2010	2013	2015	2018
inne	Number of CPT codes for MRI	0	0	0	0	0	0	0	0	6			35				65				68	68
	Number of types of image contrast in routine brain protocol, eg r/o MS							~3														~6
t al	Number of images in routine head protocol, eg r/o MS							~50														~500





Conclusions, and Invitation for Suggestions and Other Comments

The prevalent trend is upward and onward. This suggests that MRI is still dynamically evolving and growing, in multiple dimensions, approaching its first half-century. Comments on this data and these trends – as well as suggestions for other themes and threads – are welcome and appreciated

Selected References

Applicat

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