



Regenerative Medicine in Korea: Commercial Development and Industry

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Today's Talk

- I** Products & Clinical Trials
- II** Companies & CARM
- III** Regulation & Reimbursement
- VI** Investment & Ecosystem
- V** Conclusion



I . RM Products & Clinical Trials

Regenerative Medicine in the Global Market

	Products (Approvals)	Cell Sources			Gene		Medical Device
		Stem Cells	Immune Cells	Somatic Cells	w/ cells	w/o cells	
Korea	16(17)	4	2	10(11)^{a)}			
USA	22(24)	8 ^{b)}	3(4) ^{c)}	8(9) ^{d)}	2(3)	3 ^{f)}	5(6)
EU	9/5	3	3/1 ^{c)}	1	4/2	2/0 ^{f)}	
Japan	7/6(8)	2 ^{e)}	1/0 ^{c)}	3(4)	1/0	1	3(4)
Canada	2/0	1/0 ^{e)}	1/0 ^{c)}		1		
New Zealand	1/0	1/0 ^{e)}					
Australia	1/0		1/0 ^{c)}		1		
Total	58/49(62)	19/17(19)	11/6(12)	22(25)	9/6(10)	6/4(6)	8(10)

a) 1 minimal manipulation, 2 tissue engineering products, 1 gene-modified cells (gene therapy)

b) All minimal manipulations using cord blood HPCs

c) Kymriah is approved in USA, EU, Canada, Japan & Australia. Yescarta is approved in USA and EU

d) 4 out of 7 are approved as a medical device

e) Prochymal is approved in Canada, New Zealand (2012) and Japan (2015)

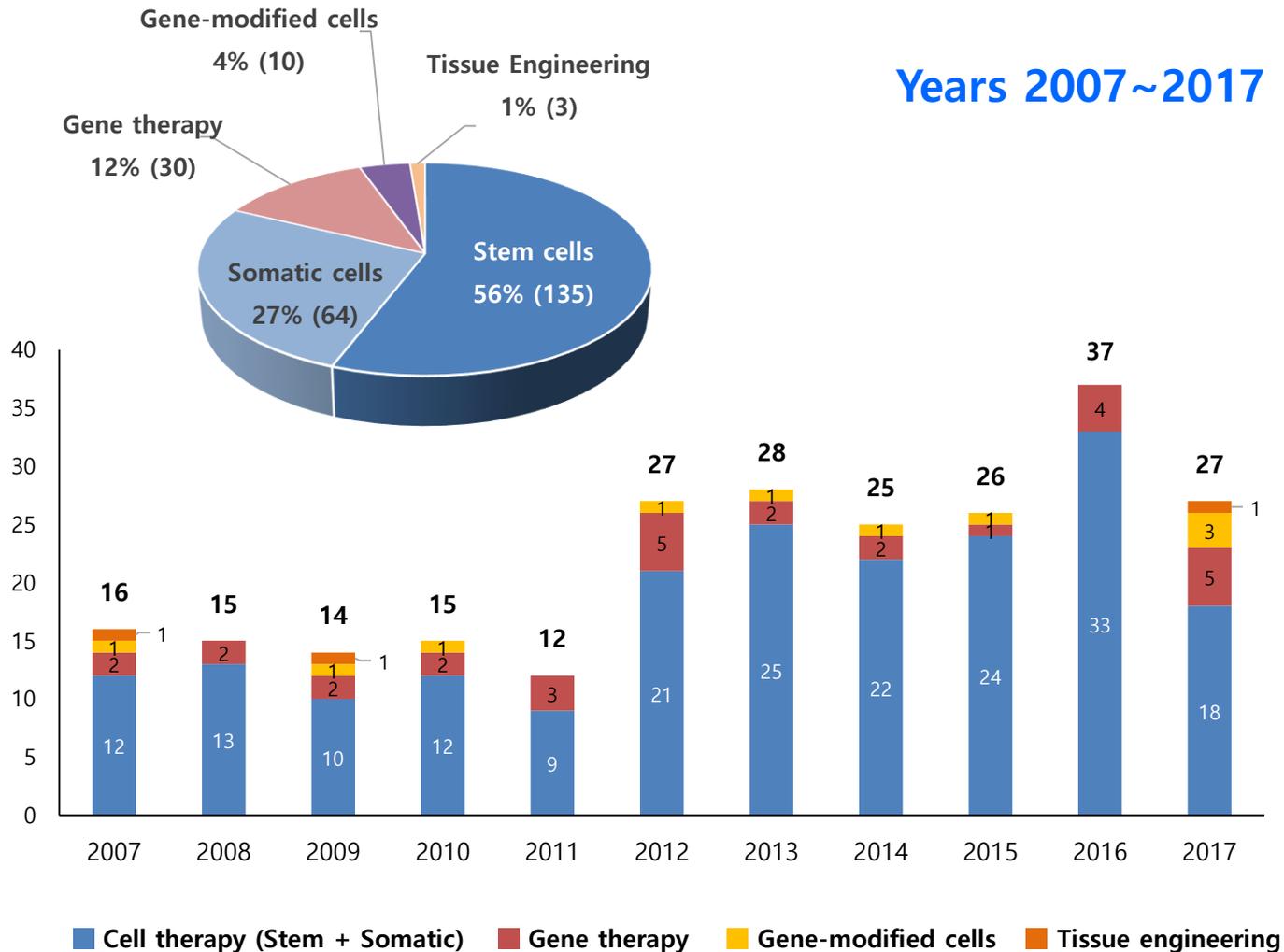
f) Imlygic and Luxturna are approved in USA and EU

As of June 2019

List of the RM Products in Korea

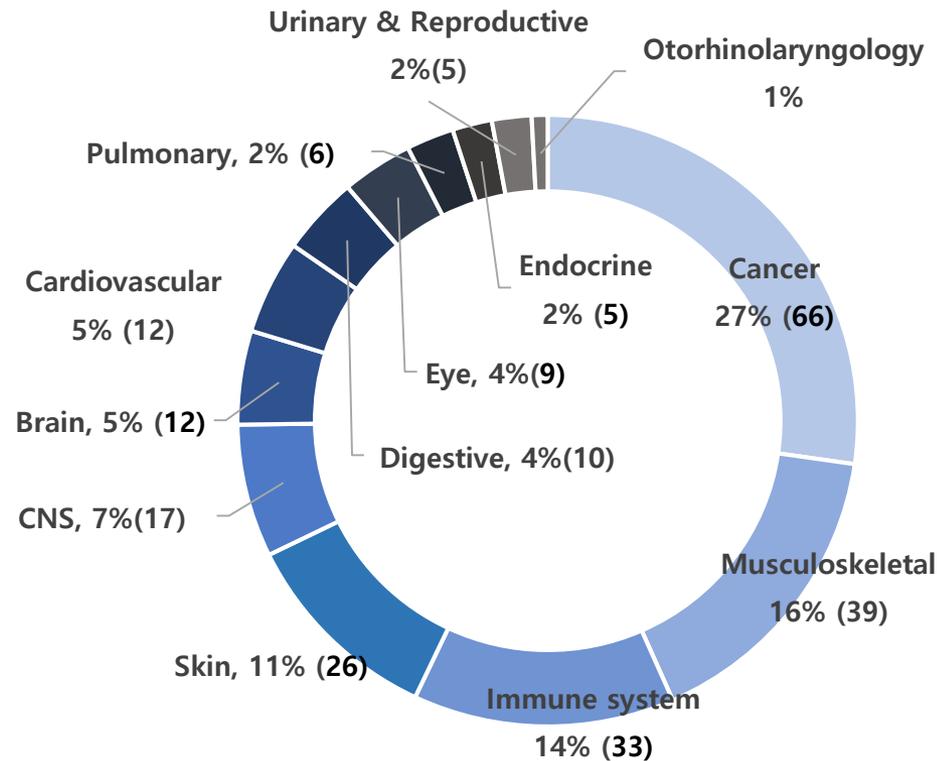
Order	Trade name	Company	Category	Characteristic	Target Disease	Approval
1	Chondron	SewonCellontech	Autologous	Chondrocyte	Knee cartilage defect	Feb. 2001
2	Holoderm	Tegoscience	Autologous	Skin Keratinocyte	Skin burn therapy	Dec. 2002
3	Kaloderm	Tegoscience	Allogeneic	Skin Keratinocyte	Skin burn therapy Diabetic foot ulcer	Mar. 2005 Jun. 2010
4	Keraheal	MCTT	Autologous	Skin Keratinocyte	Skin burn therapy	May. 2006
5	CreaVax-RCC Inj	Creagene	Autologous	Dendritic cell	Metastatic renal cell carcinoma	May. 2007
6	Immuncell-LC	Innocell	Autologous	Activated T Lymphocytes	Hepatocellular carcinoma	June. 2007
7	RMS Ossron	SewonCellontech	Autologous	Osteocyte	Local osteoblastic palpation	Aug. 2009
8	Queen cell	Anterogen	Autologous	Minimum operation	Remediation of hypodermic fat defective location	Mar. 2010
9	Cure skin	Sbiomedics	Autologous	Fibroblast	Remediation of hypodermic fat defective location	May. 2010
10	Heaticellgram-AMI	FCB Pharmacell	Autologous	BM MSCs	Acute myocardial infarction	Jul. 2011
11	Cupistem	Antrogen	Autologous	Adipose MSCs	Crohn's fistula	Jan. 2012
12	Cartistem	Medipost	Allogeneic	UCB MSCs	Knee cartilage defect	Jan. 2012
13	Neuronata-R	Corestem	Autologous	BM MSCs	ALS (Lou Gehrig's Disease)	Jul. 2014
14	Keraheal-Allo	MCTT	Allogeneic	Skin Keratinocyte	Skin burn therapy	Dec. 2015
15	ROSMIR®	Tegoscience	Autologous	Cultured fibroblasts	Nasojugal groove	Dec. 2017
16	CartiLife	Biosolutiokns	Autologous	Costal chondrocytes (micro-spheroids)	Knee cartilage defect	Apr. 2019

Clinical Trials in Korea by Product Types



Clinical Trials in Korea by Indications

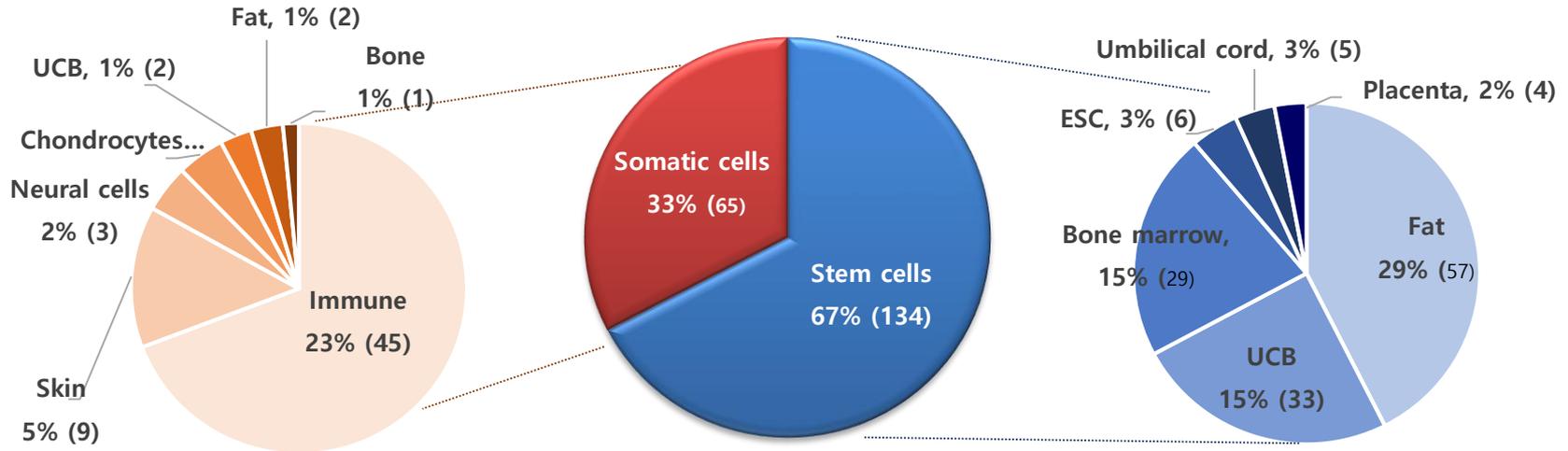
Years 2007~2017



※ SCRM 자료 (2018. 11)

Clinical Trials in Korea by Cell Types

Years 2007~2017



※ SCRM 자료 (2018. 11)

Phase 1 & 2 Clinical Trials in Korea

Company Name	Trade Name	Target Disease	Clinical Phase	Designation
ViroMed	VM202-ALS	Amyotrophic Lateral Sclerosis,	Phase 2 in Korea	
	VM202-CAD	Ischemic heart disease (Coronary Artery Disease)	Phase 2 in US	
Anterogen	ALLO-ASC-DFU	Diabetic Foot Ulcer	Phase 2 in US	
Anterogen	ALLO-ASC-DEB	Dystrophic Epidermolysis Bullosa	Phase 1/2 in Korea	Orphan drug designation in US Applied to SAKIGAKE designation in Japan
Anterogen	ALLO-ASC-BI	Burn Injury	Phase 2 in Korea	
CreaGene	CreaVax-RA	Rheumatoid Arthritis	Phase 2 in Korea	
CreaGene	CreaVax-PC	Prostatic Cancer	Phase 2 in Korea	
Genexine	GX-188E	Pre-Cervical Cancer(High Grade Squamous Intraepithelial, HSIL)	Phase 2 in Korea Phase 2 in EU	
Medipost	Pneumostem	Preventative treatment of Bronchopulmonary Dysplasia	Phase 2 in Korea Phase 1/2 in US	Orphan drug designation in the US and EU

※ SCRM 자료 (2019. Apr)

Phase 2 & 3 Clinical Trials in Korea

Company Name	Trade Name	Target Disease	Clinical Phase	Designation
ViroMed	VM202-DPN	Painful Diabetic Peripheral Neuropathy	Phase 3 in US	RMAT designation in US
ViroMed	VM202-PAD	Non-healing ischemic foot ulcers in patients with diabetes	Phase 3 in US Phase 3 in China	
Antrogen	ALLO-ASC-DFU	Diabetic Foot Ulcer	Phase 3 in Korea	
JW CreaGene	CreaVax-HCC	Hepatocellular Carcinoma	Phase 3 in Korea	
Pharmicell	Cellgram_IS	Acute cerebral infarction	Phase 3 in Korea	
KangStem Biotech	Furestem-AD	Atopic Disease	Phase 2 in EU Phase 3 in Korea	
Sillajen	Pexa Vec	Hepatocellular Carcinoma	Phase 3 in US Phase 3 in Korea	

※ SCRM 자료 (2019. Apr)



II. RM Companies & CARM

CARM, Council for Advanced RM

- ▶ CARM is a RM company association in Korea
- ▶ CARM started with 25 members in May 2016 with the support of MoHW, Korea
- ▶ As of Jun. 2019, it has 61 members total as below.

Therapeutics*	Enabling technology**	Others			No. of CARM Members
		CRO, CMO	Investment Co.	Related Associations	
34	8	11	6	2	61

* Therapeutics: Cell Therapy, Gene & Gene modified Cell therapy, Biomaterials & Tissue Engineering

** Enabling technology: Bioreactor, Tools, Media, & Logistics etc.



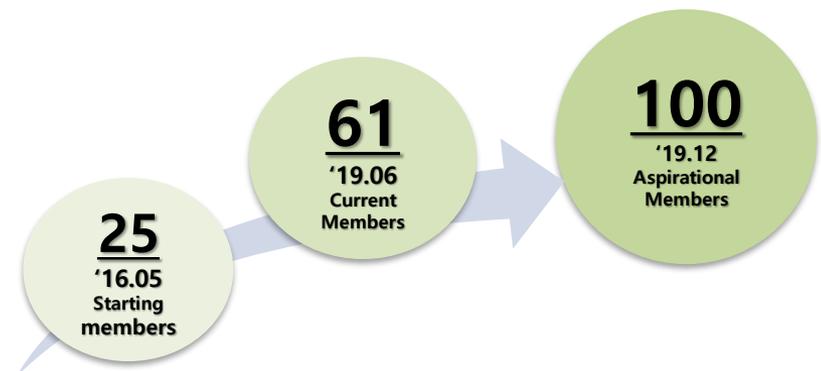
Kwang Yul Cha

- Former Chairman, CARM
- Former President, CHA Health Systems



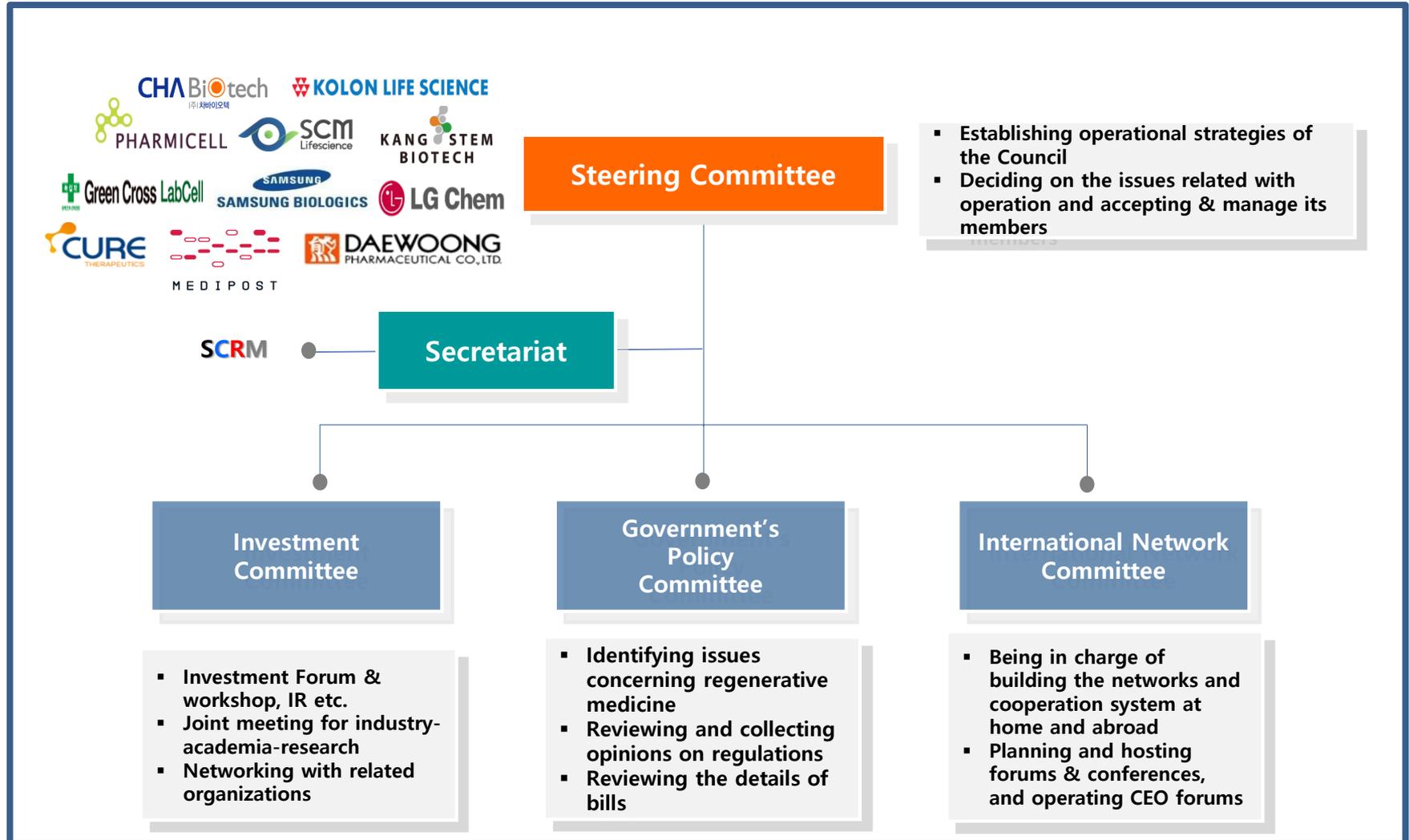
BG Rhee

- Current Chairman, CARM
- CEO, SCM Lifescience
- Board Member, ARM

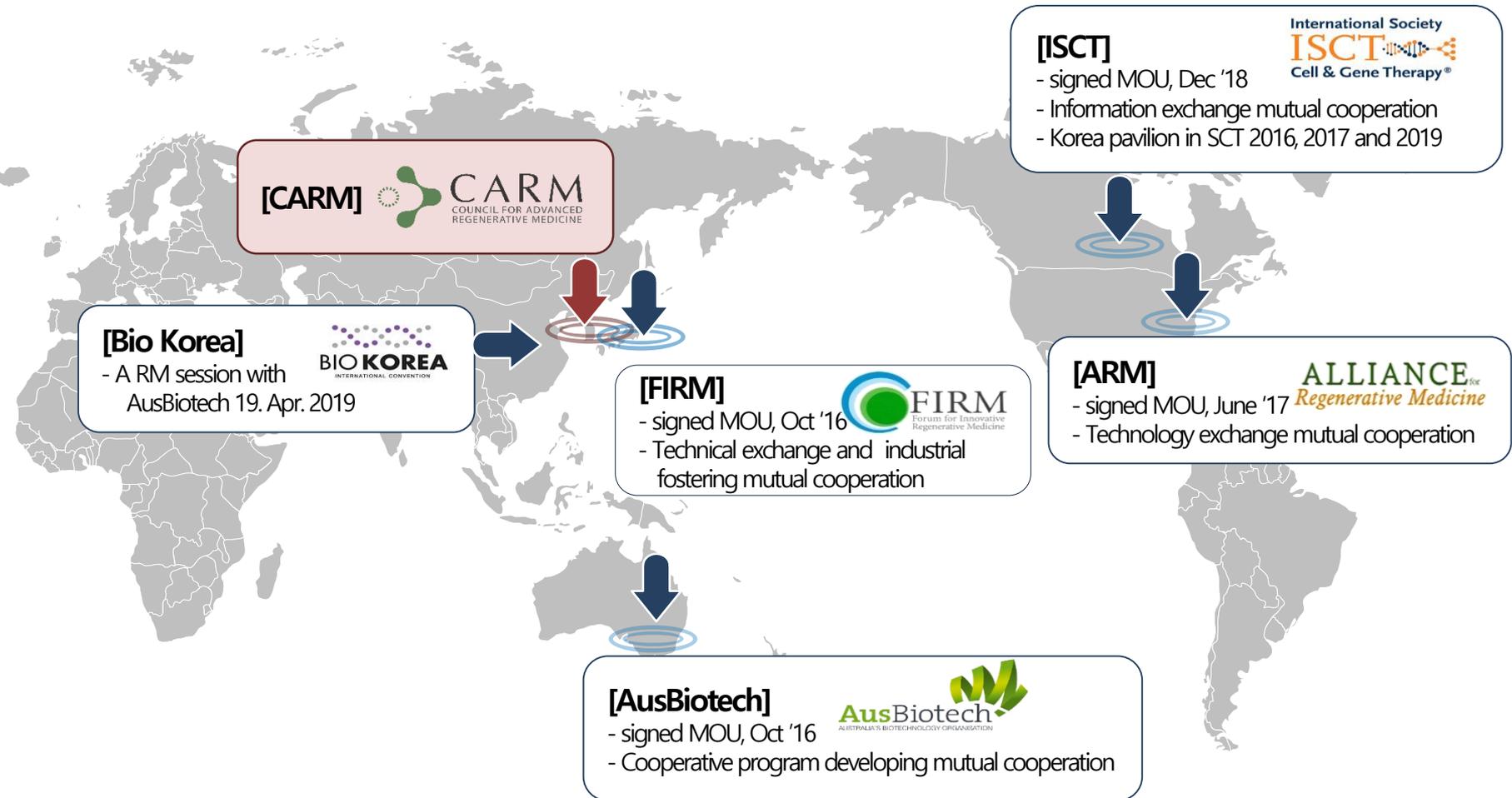


Organization of CARM

- ▶ CARM has **1 steering committee** and **3 technical committees**.
- ▶ **SCRM** plays a secretariat of CARM



➤ Council for Advanced Regenerative Medicine (CARM), a RM company alliance in Korea, has been launched in 2016 by the support of MHoW



▶ Tech transfer & marketing right

➤ **SK Bioland**

- Furestem AD developed from KangStem Biotech
 - UCB-derived MSCs for atopic dermatitis
 - Signed a license for manufacturing and marketing right in Korea (Mar. 2019, \$13.2M for an upfront payment)
- Cartistem developed from Medipost
 - Marketing right in Korea for application to ankle joint (Dec. 2018)



➤ **Kolong Tissuegene**– Invossa

- Gene-modified cell therapy for Osteoarthritis
- Licensed-out to Mundipharma, Japanese company (Nov. 2018) (for total contract amount 591 million USD)



➤ **Hanmi Pharmaceutical** – Gene-modified MSCs for glioblastoma

- Tech-transfer from Ajou Univ. in Dec. 2016 and CMO contract with ENCell (Jan. 2019)



Activities of Big Pharma Companies in Korea

▶ M&A

➤ **LG Chemical** – CAR-T and other I-O, MSCs

- Merged LG Life Science again to spur up the business including cell therapy (Jan. 2017)



➤ **Boryung Pharmaceutical** – CTL therapy, gene therapy

- Merged Vigencell to step in the cell therapy sector (Jul. 2016)



▶ New Business

➤ **Samsung Biologics** – CDMO

- CDO contract for immunotherapy (Mar. 2019)
- Aim to CDO and CRO partnerships up to 50 companies



➤ **Daewoong Pharmaceuticals** – ESC-based MSCs & UCB MSCs

- One stop POC center, GMP for stem cell therapeutics
- Collaboration for cell therapy development with KangStem Biotech except FureStem
- Open collaboration with other biotech companies and academia

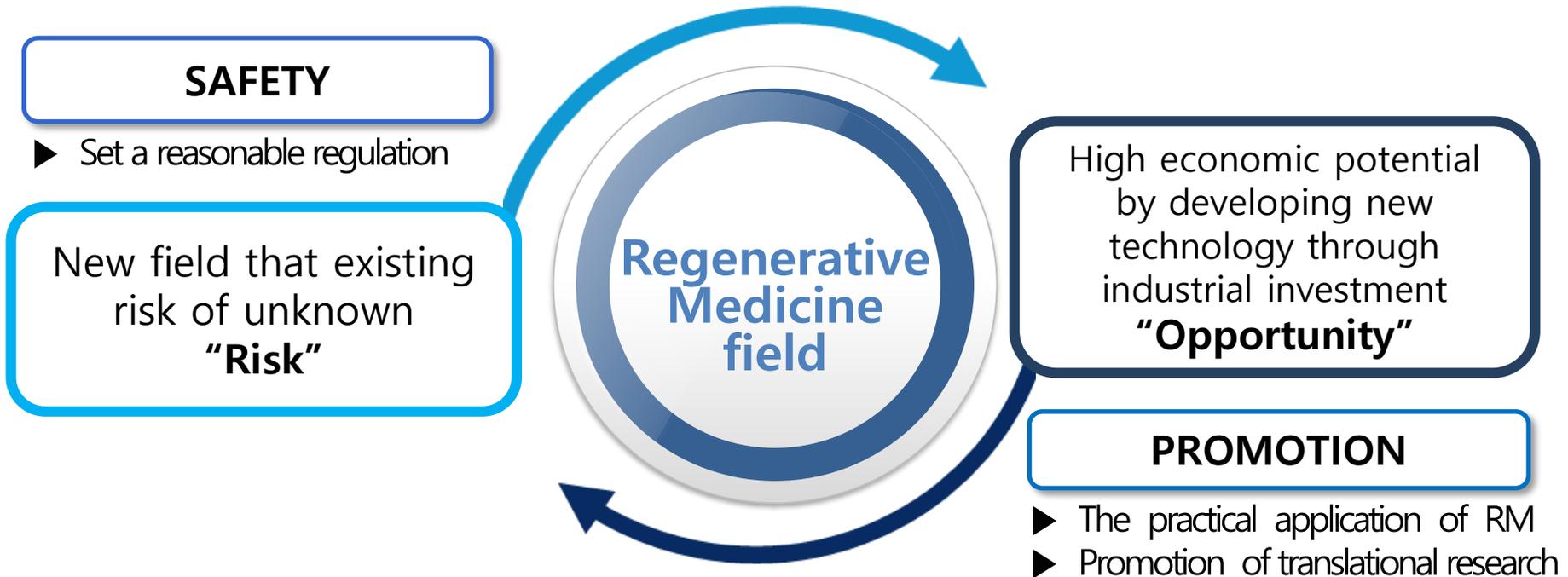




III. Regulation & Reimbursement

Bill on the Support & Management of RM

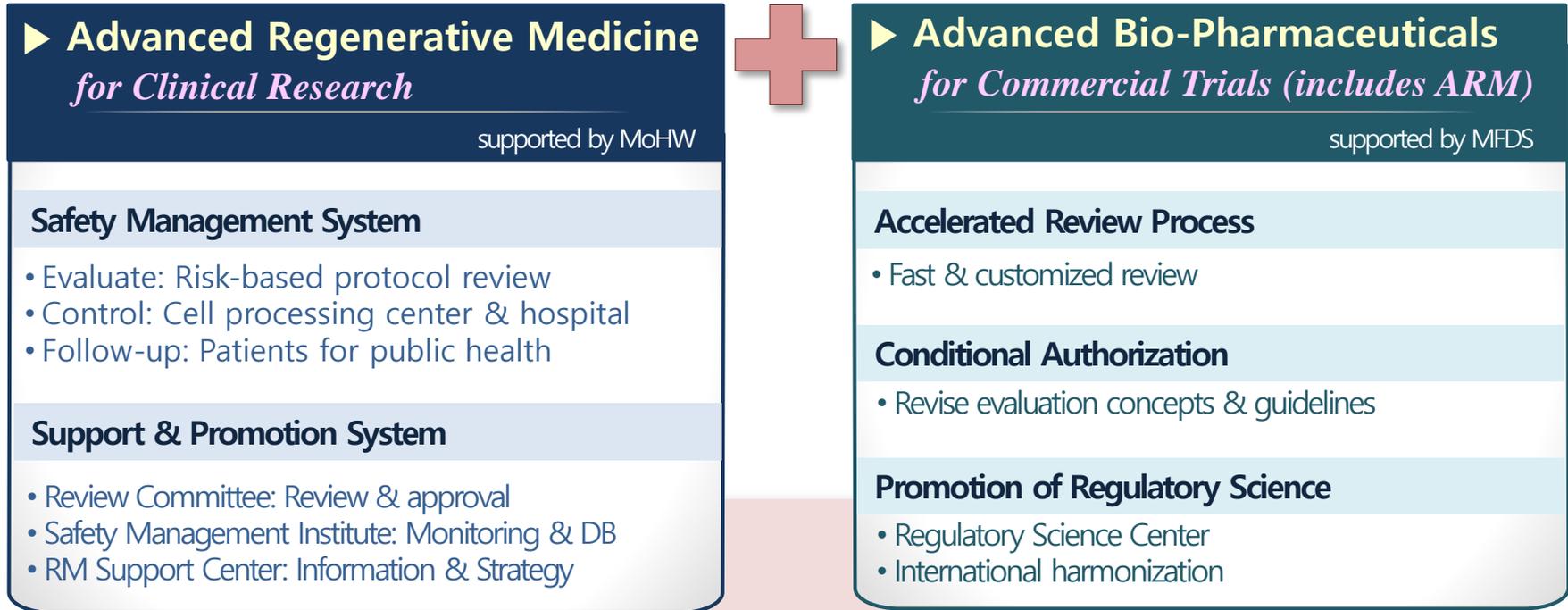
- Supported by Ministry of Health and Welfare, and other related Ministry
- Structure is based on the 2 pillars of safety and promotion



- ※ "Bill on the support and management of Advanced RM" (2016.06)
- "Bill on the support and Safe Management of Advanced RM" (2016.11)

A New Bill on Advanced RM and BP

Bill on the Advanced RM and Advanced Bio-Pharmaceuticals



Currently at the final stage in the Congress ('19. 07)

➤ Upgrade the regulatory framework

- Innovation in the regulatory principles, tools and process
- Monitoring & management for safety & efficacy during the whole treatment cycle

➤ Facilitate patients access to ARM & ABP

- Providing more therapeutic opportunities to incurable or orphan diseases
- Enabling safe use of novel therapies & improved health care

➤ Promote product commercialization and industry

- Better understanding about the attributes & behavior of ARM in patients
- Less uncertainties, affordable process & expedited approval

Reimbursement of RM Products in Korea

- ▶ Among the 16 cell & gene therapeutics, 4 products are covered by National Health Insurance (NHI)
- ▶ Private health insurance covers up to 90% of medical cost that is not covered by NHI

RM Products (16)	NHI (HIRA, NHIS)	Private Health Insurance
Chondron	Covering Max. 5,753 USD	<ul style="list-style-type: none"> • Covering 90% of medical cost • 66.3% of Koreans are covered by the private health insurance
Kalodem	Covering Max. 305 USD (56cm ² /1sheet)	
Keraheal-Allo	Covering Max. 585 USD (2x10 ⁷ /1.5 mL)	
Cupistem	Covering (90%)* as an orphan drug 11,868 USD/ mL	
The other 12 therapies including Neuronata-R	Not covered by NHI	

*Neuronata-R is not covered by NHI because it was approved for using in combination with Riluzole treatment only.

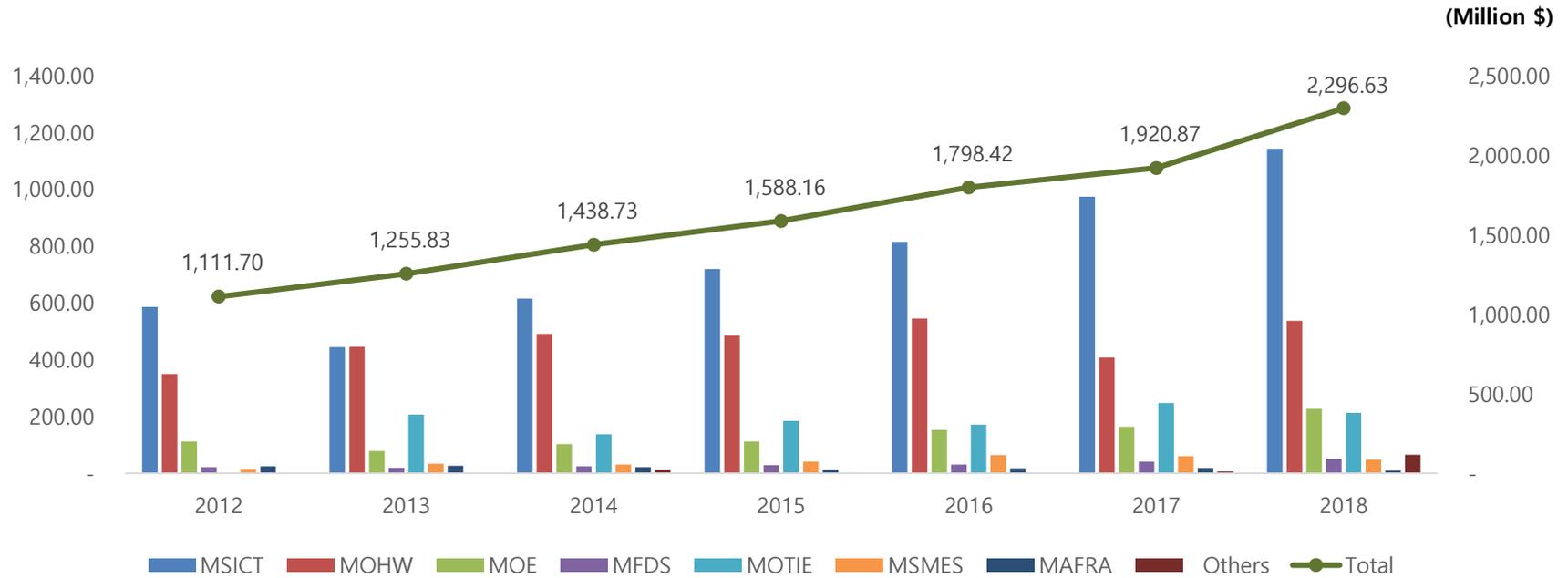
※ 1dollar = 1,136won ('19'04'05)

※ Source :Health insurance review& assessment service 2018



IV. Investment & Ecosystem

Government Fund for Stem Cell and RM



(Million \$)

Funding Agencies	2012	2013	2014	2015	2016	2017	2018
Ministry of Science and ICT (MSICT)	586.61	444.27	615.29	719.38	815.69	974.87	1,143.49
Ministry of Health and Welfare (MOHW)	349.79	445.21	491.28	485.47	544.97	407.81	537.04
Ministry of Education (MOE)	112.7	78.41	103.59	112.13	152.64	164.36	227.98
Ministry of Food and Drug Safety (MFDS)	21.9	19.63	25.2	28.6	31.1	40.61	51.43
Ministry of Trade, Industry and Energy (MOTIE)	-	207.08	138.12	185.21	171.32	248.03	213.41
Ministry of SMEs and Startups (MSMES)	15.63	34.22	30.67	41.2	64.9	60.66	48.09
Ministry of Agriculture, Food and Rural Affairs (MAFRA)	25.07	27.01	21.43	13.31	17.8	18.23	9.32
Others	-	-	13.15	2.86	-	6.3	65.87
Total	1,111.70	1,255.83	1,438.73	1,588.16	1,798.42	1,920.87	2,296.63

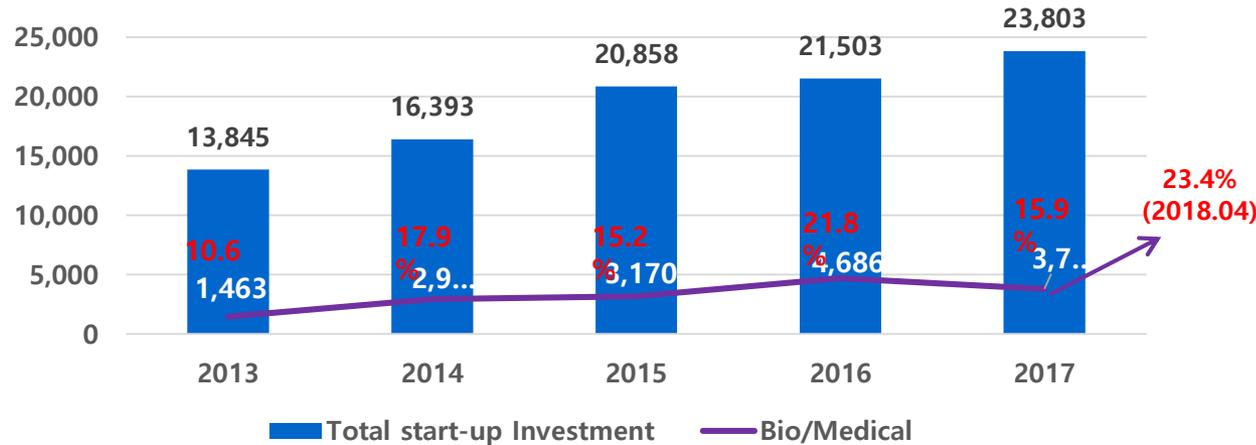
※ Source: NTIS(<https://www.ntis.go.kr>)

Private Investment in Korea's Bio-industry



- The investment made in start-ups of bioMedical sector grew every year
- The VC Association is expecting that the investment of 2018 would be more than 23.4%

(hundred million KRW)



Year of SC/RM company's list stock	
1998	1
2005	2
2006	1
2009	1
2011	1
2014	1
2015	3
2016	1
2017	1*
Total	12



Driving Force

1. As one of the 9 national focusing technology area

- Government R&D investment in 2017 is expected to be concentrated in 9 technology areas
- Government declares to eliminate the barriers in boosting creative economy

2. Special IPO provisional system of the listing on the stock with technology ratings

- 12 RM companies have been listed on the stock market through IPO (2018.04)

※ Source :Korea Venture Capital Association 2018

▶ R&D Centers, Research Hospitals, Clinical Trial Centers & CMO/CDMO

- **National Center for SC & RM**

- ✓ National SC bank, Registry Information, GMP Manufacturing Service



- **Songdo Bio complex**

- ✓ Samsung Biologics, Jansen, GE Healthcare, Celltrion etc.
- ✓ IFEZ: Tax benefits, Deregulation for hassle-free business, Financial/Site support, Admin support, One-stop Service etc.



- **Ranked in 6th among the countries conducting clinical trials**

- ✓ Seoul is the No. 1 city in the world in the number of clinical trials
- ✓ Provides very cheap and high quality clinical trials

- **Korean CMO/CDMO business arises**

- ✓ Developing cell manufacturing technology (e.g. CureCell, Center for Disease Control, Cdmogen etc.)



- **10 Korea Research-driven Hospitals (KRH)**

- ✓ knowledge accumulated based on clinical trials to accelerate commercialization of HT R&D

▶ There are 10 different KRHs designated by the MoHW

Hospital Name	Major Research Areas
Gachon University Gil Medical Center	Brain Conditions(Dementia, Stroke, Parkinson's Disease), Metabolic Diseases(Obesity, Diabetes, Hyperlipidemia)
Kyungpook National University	Cardiocerebrovascular Diseases, Metabolic Diseases, Cancer Diagnosis, Histology & Organ Regeneration
Kyungpook National University Hospital	Vaccine(Infection, Immunity), Diagnostic Device(Infection, Immunity, Cancer, Cardiovascular), Therapeutic Agent(Musculoskeletal, Cancer, Cardiovascular)
Korea University Anam Hospital	Genomics(Cancer, Depression), IT Fusion Technology, Stem Cell(Pluripotent, Adult) , New Drug
Cha University Bundang Medical Center	Conquest of incurable Diseases using the Stem Cell Treatment Technology (Neurological Diseases, Ophthalmological Diseases, and Musculoskeletal Diseases), Development and Commercialization of Diagnostic/Therapeutic Technologies for the Prevalent Diseases of Next Generation(Cancer, Infertility, Anti-aging)
Samsung Medical Center	Cancer, Neurology, Cardiac&Vascular, Transplantation, Genome, Stem Cell & Regenerative Medicine , Biotechnology
Seoul National University Hospital	Cancer, Inflammation-metabolics, Fusion Medical Devices, Brain-neuroscience, Biotherapeutics
Asan Medical Center	New Drug(5 Anti-cancer Drug, Infectious Diseases Drug, Senile Diseases Drug, Molecular Imaging Technology Development), Cell Therapy , Medical Device, Big Data
Ajou University Hospital	Immunological Diseases(Allergy, Autoimmune, Immune Diseases of skin), Cerebrovascular Diseases, Hearing Loss, Osteoarthritis, Geriatric Diseases
Severance Hospital	Immune/Infection, Cardio-Cerebrovascular, Metabolic Disease, Brain, Cancer, Stem Cell , Medical Devices/IT

※ Source: Korea Health Industry Development Initiative 2018



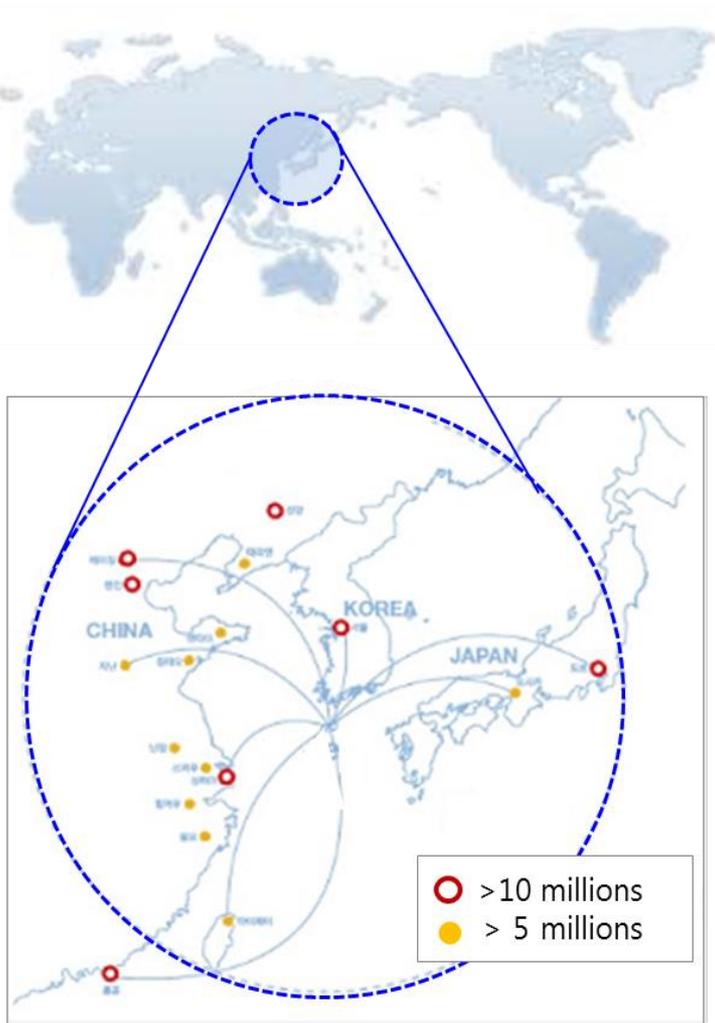
V. Conclusion

Korea: Looking at the Next Era of ARM



- ✓ The geographical center of the “most rapidly growing” market in the world
- ✓ Favorable government support with excellent regulatory environment
- ✓ Leading commercial development and technologies of RM
- ✓ First class medical centers with experienced medical scientists
- ✓ Abundant early adopters seeking advanced therapies
- ✓ Innovating patient access and translational process of RM

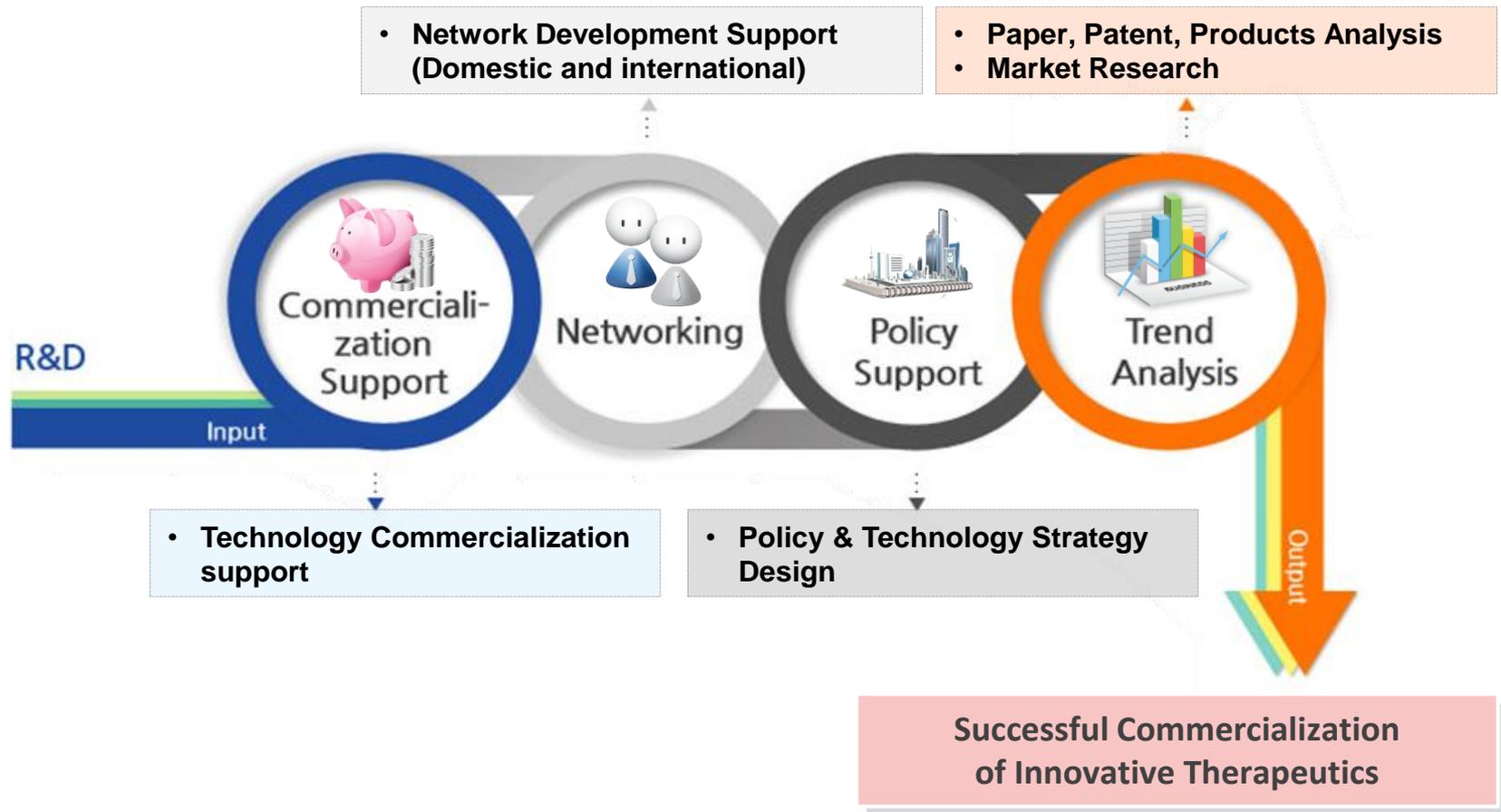
Korea As the Heart of RM in Northeast Asia



- Having the "**most number**" of cities with over 1 million people in 3½hr flight
 - More than 60 cities with over 1millions
 - Korea: Seoul, Pusan, Incheon, Ulsan, Daegu, Daejeon
 - Japan: Tokyo, Osaka, Hiroshima, Nagoya, Yokohama
 - China: Beijing, shanghai, Qingdao, Hangzhou, Dalian
 - Taiwan: Taipei, Kaohsiung
- Driving the "**most strong**" economy
 - Northeast Asia accounts for 28% of global GDP
- Located at the center of the "**fastest growing**" healthcare market in the world
 - The market share will reach 26% in 2016
 - United States 30%
 - Europe 18%

Strategic Center for Regenerative Medicine (SCRM)

- A non profit and nonpartisan strategic and operational sponsor for stem cell and RM industry
- SCRM is commissioned by MoHW in order to work on a new initiative to promote industry with hands-on support in addition to dramatically rising government grants for R&D



**New Voyage For Blue Ocean
 With Strategic Partnership Between Korean Co & Overseas Co
 Backed By Tailored Support from CARM & SCRM**

Yes, Korea !

