**Tables to be published online as supplemental materials:**

**Potential Applications of Smart Multi-Functional Wearable Materials to Gerontology,** David G. Armstrong, Bijan Najafi, Mohsen Shahinpoor

**Table 1-Electrostrictive sensors and actuators characteristics applied to aging**

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| 1a-Effects and Functions: Can be actuated in linear and bending configurations by application of a voltage, generates electricity when pressurized or flexed in sensing mode, they can sense heat and temperature variations which affects their actuation and sensing characteristics |
| 1b-Force: They generate a force upon actuation, can be designed to generate human-friendly forces and stresses in the few mega Pascal range (MPa). |
| 1c- Sensing: Can rapidly and accurately identify physiological frailty in older adults by sensing arm movements and determination of Trauma-Specific Frailty Index (TSFI). |

**Table 2-Giant Magnetostrictive Materials (GMM) as sensors and actuators characteristics applied to aging**

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| 2a-Effects and Functions: Can be used as transcutaneously actuated gates and valves for fluid drainage in the body of the elderlies. In particular can be used for urinary incontinence control or releasing of drugs inside a body or organ. |
| 2b-For any kind of internal body fluid drainage and voiding like in hydrocephalus as well as in bladder irrigation where it can be used as transcutaneously actuated gates and valves for fluid drainage or flow control in the body of after extensive use of micro catheters. |
| 2c-Force: They generate a force upon magnetostriction and can be designed to generate human-friendly forces and stresses in the body transcutaneously. |

**Table 3-Dielectric Elastomer sensors and actuators characteristics applied to aging**

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| 3a-Effects and Functions: Can be actuated to produce large deformations but require a high voltage. |
| 3b-Sensing: They can be used as capacitive sensors showing capacitance change with force, pressure or movements but requires a battery to induce capacitance in the DE and electronics to monitor the capacitance as sensing signal. |

**Table 4-Electrorheological Fluids (ERFs) sensors and actuators characteristics applied to aging**

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| 4a-Effects and Functions: Provides dynamically changing viscosity by 5-6 orders of magnitude in a fluid medium that can be employed by patients and older people to exercise movements or rehabilitate from bodily injuries by gradually increasing the viscosity of the medium during exercise. |
| 4b-Force: Smart movement rehabilitation exercisers equipped with electrically controllable ERFs. Promotes the principles of motor learning to enhance locomotor rehabilitation of individuals with lower limb damage or loss. |
| 4c-GERfs can provide constraint induced movement therapy with broad application to physical rehabilitation and recuperation |

**Table 5-Magnetic Shape Memory Materials (MSMs) sensors and actuators characteristics applied to aging**

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| 5a-Effects and Functions: Similar to SMAs, MSMs are user-friendly and rather biomimetic and slowly deforming or contracting materials that can be used for various medical applications such as deployable coronary implants and actuators. The mechanism of actuation is a magnetic field and commonly electromagnets are used for actuation. |
| 5b-Force and Pressure: They generate a strong force or pressure upon making a phase transformation from Martensite to Austenite which translate to contraction of an MSM wire in a progressive and ordered manner to create a massaging action on tissues of the legs or other parts of the body such the legs to prevent swelling and DVT or deep vein thrombosis. |

**Table 6-Shape Memory Polymers (SMPs) sensors and actuators characteristics applied to aging**

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| 6a-Effects and Functions: They are user-friendly and rather biomimetic and slowly deforming or contracting materials that can be used for various medical applications. The mechanism of actuation is heat but the mechanism of contraction is different from SMAs and is largely due to glass transition |
| 6b- Force and Pressure: They do not generate forces comparable to SMAs. Thus, they may not be able to compete with SMAs or even MSMs or magnetic shape memory alloys |

**Table 7-Ionic Polymer Metal Composites (IPMCs) sensors and actuators characteristics applied to aging**

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| 7a-Effects and Functions: Can be actuated in linear and bending configurations by application of a voltage, generates electricity when pressurized or flexed in sensing mode, they can sense heat and temperature variations which affects their actuation and sensing characteristics |
| 7b-Force: They generate a force upon actuation, can be designed to generate human-friendly forces and stresses in the few tens of mega Pascal range (MPa). |
| 7c-They can be used in wearable fabrics, as sensors, to monitor bodily movement and detect impending falls or progressive frailty. |

**Table 8-Carbon Nanotubes (CNTs) sensors and actuators characteristics applied to aging**

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| 8a-Effects and Functions: These smart multi-functional materials can be possibly used in gerontology and geriatric research. Their advantage is having a very high conductivity which may translate to detection of body voltage and current in various parts of the body. |

**Table 9-Likely Possibilities for Applicability of Various Smart Materials.**

**Showing Strong Applicability (++), Applicability (+), Possible Applicability (+-) and No-applicability (-) of Various Smart Materials to Aging:**

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| **Fall Prevention / Pre-sensing/Proprioceptive Feedback.** IPMCs (++), PEMs (++), PRMs(+), ESMs(+), GMMs(+), GMRs(+-), DEs (-), ERFs (+-), MRFs (+-), SMAs (++), MSMs (+-), SMPs (+), CNTs (-), Graphene (-) |
| **2. "Pre" Habilitation** IPMCs (++), PEMs (+-), PRMs(+), ESMs(+-), GMMs(+-), GMRs(+-), DEs (-), ERFs (+-), MRFs (+-), SMAs (+), MSMs (+-), SMPs (+-), CNTs (-), Graphene (-) |
| **3. Gamification of Balance Training**   IPMCs (++), PEMs (++), PRMs(+), ESMs(+-), GMMs(+-), GMRs(+-), DEs (-), ERFs (+-), MRFs (+-), SMAs (++), MSMs (+-), SMPs (+-), CNTs (-), Graphene (-) |
| **4. Inflammometry**   IPMCs (++), PEMs (+-), PRMs(+), ESMs(-), GMMs(+-), GMRs(+-), DEs (-), ERFs (-), MRFs (-), SMAs (++), MSMs (+-), SMPs (+-), CNTs (-), Graphene (-) |
| **5. Oximetry in the Periphery for Peripheral Artery Disease**  IPMCs (++), PEMs (+-), PRMs(+-), ESMs(-), GMMs(-), GMRs(+-), DEs (-), ERFs (-), MRFs (-), SMAs (++), MSMs (+-), SMPs (+-), CNTs (-), Graphene (-) |
| **6. Identifying Arrhythmia or Predicting Heart Attack**  IPMCs (++), PEMs (+-), PRMs(+-), ESMs(-), GMMs(+-), GMRs(+-), DEs (-), ERFs (-), MRFs (-), SMAs (++), MSMs (+-), SMPs (+-), CNTs (-), Graphene (-) |
| **7. Preventing Bedsores**   IPMCs (++), PEMs (++), PRMs(+), ESMs(+), GMMs(+), GMRs(+-), DEs (-), ERFs (+-), MRFs (+-), SMAs (++), MSMs (+-), SMPs (+), CNTs (-), Graphene (-) |
| **8. Improving Function of Orthoses/Prostheses Through Energy Return**   IPMCs (++), PEMs (++), PRMs(+), ESMs(+), GMMs(+), GMRs(+-), DEs (-), ERFs (+-), MRFs (+-), SMAs (++), MSMs (+-), SMPs (+), CNTs (-), Graphene (-) |
| **9- Personalized Rehabilitation of Diabetic Patients with Peripheral Neuropathy [39]**   IPMCs (++), PEMs (++), PRMs(+), ESMs(+), GMMs(+), GMRs(+-), DEs (+-), ERFs (+), MRFs (+), SMAs (++), MSMs (+-), SMPs (+), CNTs (-), Graphene (-) |
| **10- Improving Perception of Motor Errors in Diabetes**   IPMCs (++), PEMs (++), PRMs(+), ESMs(+), GMMs(+), GMRs(+-), DEs (-), ERFs (+), MRFs (+), SMAs (++), MSMs (+), SMPs (+), CNTs (-), Graphene (-) |
| **11-Parkinson Disease and Ocular Micro Tremors**  IPMCs (++), PEMs (++), PRMs(+), ESMs(+), GMMs(+), GMRs(+-), DEs (-), ERFs (+-), MRFs (+-), SMAs (++), MSMs (+-), SMPs (+), CNTs (-), Graphene (-) |
| **12-Diabetes, Diabetic Peripheral Neuropathy (DPN)**  IPMCs (++), PEMs (++), PRMs(+), ESMs(+), GMMs(+), GMRs(+-), DEs (+-), ERFs (+), MRFs (+), SMAs (++), MSMs (+-), SMPs (+), CNTs (-), Graphene (-) |
| **13-Heart Failure, Congested Hearts, Weak Hearts**   IPMCs (++), PEMs (++), PRMs(+), ESMs(+), GMMs(+), GMRs(+-), DEs (-), ERFs (+-), MRFs (+-), SMAs (++), MSMs (+-), SMPs (+), CNTs (-), Graphene (-) |
| **14-Osteoarthritis**   IPMCs (++), PEMs (++), PRMs(+), ESMs(+), GMMs(+), GMRs(+-), DEs (-), ERFs (+), MRFs (+), SMAs (++), MSMs (+-), SMPs (+), CNTs (-), Graphene (-) |
| **15-Chronic Obstructive Pulmonary Disease (COPD)**   IPMCs (++), PEMs (++), PRMs(+), ESMs(+), GMMs(+), GMRs(+-), DEs (-), ERFs (+-), MRFs (+-), SMAs (++), MSMs (+-), SMPs (+), CNTs (-), Graphene (-) |
| **16-Geriatric Syndromes such as Falls, Frailty, Urinary Incontinence**   IPMCs (++), PEMs (++), PRMs(+), ESMs(+), GMMs(+), GMRs(+-), DEs (-), ERFs (+), MRFs (+), SMAs (++), MSMs (+), SMPs (+), CNTs (-), Graphene (-) |
| **17-Urinary Micro Catheters and Ensuing Bladder Irrigation for the Elderly**   IPMCs (++), PEMs (++), PRMs(+), ESMs(+), GMMs(+), GMRs(+-), DEs (-), ERFs (+-), MRFs (+-), SMAs (++), MSMs (+-), SMPs (+), CNTs (-), Graphene (-) |