ADVANCING STANDARDS
TRANSFORMING MARKETS

EMERGING AIRSPACE

HEALTH AND SAFETY

ADVANCED MANUFACTURING

BUILT ENVIRONMENT AND INFRASTRUCTURE SYSTEMS

CLEAN ENERGY AND DECARBONIZATION TECHNOLOGY

Standardization Impact Report

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Health and Safety

RELEVANT ASTM COMMITTEES

Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants

Committee D15 on Engine Coolants and Related Fluids

Committee E50 on Environmental Assessment, Risk Management and Corrective Action

Committee E60 on Sustainability

Committee F04 on Medical and Surgical Materials and Devices

Committee F08 on Sports Equipment, Playing Surfaces, and Facilities

Committee F15 on Consumer Products

Committee F23 on Personal Protective Clothing and Equipment

Committee F24 on Amusement Rides and Devices

Committee F27 on Snow and Water Sports

Committee F49 on Digital Information in the Supply Chain

Safety and sustainability are increasingly linked as drivers in today's competitive global marketplace. The medical field in particular is on the cusp of transformative change, thanks to emerging technologies such as AI-enhanced medical imaging and diagnosis, wearable and portable health monitoring devices, nanotechnology, and 3D printing of medical devices and supplies.

Similarly, AI is a tool that could offer enormous benefits to many fields, but also brings its own safety risks, particularly if it is used as part of the medical decision-making process.

There is a significant opportunity for standards to help improve the sustainability of products and benefit the environment by enabling more responsible production. Standards will also be critical in harnessing the potential of emerging tools and practices with significant safety implications by helping to manage the risks and increase awareness of their capabilities and limitations.

Health and Safety
Consumer Safety

Over the years, ASTM International has been a key resource for protecting consumer safety by developing standards to deal with new and emerging hazards caused by use and foreseeable misuse of consumer products in several categories — especially for those that are intended for use by children. This work became even more crucial in 2008 after a spate of recalls led the U.S. Congress to pass the Consumer Product Safety Improvement Act (CPSIA), a mandate that has placed additional responsibilities on the U.S. Consumer Product Safety Commission (CPSC) and on ASTM, by charting a preference for the adoption of ASTM's voluntary consensus consumer product standards as the basis of product safety requirements.

The consumer safety space is evolving. Circular economy practices have become an increasing area of focus due to a deepening understanding of the opportunity for standards to support sustainability efforts and benefit the public and the environment over time. As part of this, major manufacturers have been re-evaluating the use of toxic chemicals and implementing Industry 4.0 technologies to gain a more detailed understanding of their manufacturing processes to improve product quality. In addition, many manufacturers are now using smart labels to meet increasing consumer demand for transparency and traceability of the products they buy. Emerging technologies such as AI and electric, automated, and micromobility vehicles have also brought new safety concerns, and there have been calls for increased oversight and standards for these products.

FUTURE OF CONSUMER SAFETY

ASTM NEWS STORIES

- Case Study on Standards: Baby Cribs
- Sustainability Committee Publishes Report on Circular Economy Symposium
- Clothing Storage Units Standard
- 50 Years of Consumer Safety: Responding to Hazardous Toys, Lighters, Furniture, and More
- New Subcommittee To Focus on Chemical Substances in Consumer Products
- Standards and Consumer Safety
- Standards Address PFAS in Everyday Products
- Case Study on Standards: Amusement Rides

U.N. Sustainable Development Goals Supported

MARKET SIZE

The global consumer product safety testing market reached an estimated $33.1B in 2021 and is expected to grow to $60.5B by 2031, with a compound annual growth rate of 6.32% from 2022 to 2031.[1] The recent growth has been driven by a range of factors, with two trends standing out: manufacturers increasing their focus on product quality to improve customer retention; and the increased demand for interoperability testing for connected devices and the IoT, an area with significant implications for consumer safety. Conversely, the high cost of safety testing services due to differing standards and regulations from region to region is a limiting factor for the growth of this market.[2]

LANDMARK LEGISLATION

In 2008, Congress created a paradigm shift with the passage of the Consumer Product Safety Improvement Act (CPSIA). The law mandated that certain children's product standards in the United States such as those dealing with toys and durable infant or toddler products, shift from being voluntary to mandatory. ASTM International and its stakeholders in Committee F15 played a critical role in assisting CPSC to effectively implement this mandate. With tight deadlines to establish lifesaving, federal standards for toys, cribs, and numerous juvenile products, it was vital that the technical staff at CPSC have confidence that they could use and build from the existing voluntary standards. The longstanding relationships that CPSC technical staff have with the chairs and members of the F963 group and the F15 subcommittees on juvenile products were key in the successful implementation of the new law.[3]

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INFANT PRODUCT SAFETY

New Law Aimed at Increasing Sleeping Equipment Safety. After reports of tragedies and emerging hazards in the marketplace, a new regulation was introduced by the Consumer Product Safety Commission (CPSC) that requires all baby sleeping equipment to comply with federal standards.[4]

Increasing Awareness of Secondhand Market Risks. Online marketplaces and secondhand sellers pose risks to consumer safety of babies and toddlers, as they may offer products that are no longer in compliance with current safety standards. There is a tremendous focus by regulatory agencies to police these marketplaces to assure that products are compliant when offered for sale and punitive efforts have been put in place to hold platforms accountable when products that do not conform to current safety standards are offered for sale to an unknowing public.

CONSUMER SAFETY FOR INNOVATIVE PRODUCTS

Electric Vehicle Safety and Reliability Issues. Consumer Reports ranked electric vehicles as the least reliable trucks and cars in the automotive industry in 2023. Many electric vehicle models have reliability issues, such as problems with innovative features.[5] Automated driving features are of particular concern. In a recent poll, 40% of respondents said they would feel much less safe on the road with a driverless automobile and 45% expressed concern about risk to pedestrians.[6] Auto safety testers are investing in newer testing equipment suitable for electric vehicles, which are heavier due to their battery weight and often cannot be tested effectively using conventional methods.[7]

Need for Artificial Intelligence Standards and Oversight. As new AI tools see increased use and grow more prominent, there have been calls for increased attention to their impact on consumers.

Action by Regulatory Agencies. U.S. Regulatory agencies like the Consumer Finance Protection Bureau, the Federal Trade Commission, the Equal Employment Opportunity Commission, and the Department of Justice are directing resources and staff toward ensuring that AI tools like ChatGPT comply with current laws related to consumer safety.[8]

Fire Risk from Micromobility Vehicles Such as e-Bikes and e-Scooters. Since the start of 2023, malfunctioning lithium-ion batteries in micromobility vehicles have led to 76 fires, 58 injuries, and 9 deaths in New York City. Use of these vehicles has been growing, particularly in dense cities and for applications like food delivery services. Consequently, this is an important issue from a consumer safety standpoint. In response to these incidents, representatives in Congress have put forth the Setting Consumer Standards for Lithium-Ion Batteries Act, which aims to protect consumers from the risk of fires associated with micromobility vehicles.[9]

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INDUSTRY 4.0 SYSTEMS CAN IMPROVE CONSUMER SAFETY

Industry 4.0 systems and tools can improve the traceability of the production process. Industry 4.0 makes it easier to see where manufacturing failed and produced a product error, thus increasing quality and consumer safety.[10] Industry 4.0 elements like automation and social networks are currently being implemented by product manufacturers and packaging companies.[11] Industry 4.0 technology such as the IoT can also be used to track product performance while in use, recommending maintenance and identifying malfunctions.

USE OF SMART LABELS AND BLOCKCHAIN TO INCREASE TRANSPARENCY

Through a quick-response (QR) code, Radio Frequency Identification (RFID), Near Field Communication (NFC), or other digital portal, smart labels provide extended product information, which can include multimedia, authentication, and messaging. Smart labels typically offer more transparency compared with traditional labels, which allows consumers to determine if the product is right for them from a safety standpoint. In addition, the unique product ID can be tied to blockchain to increase security.[12] Smart labels can also aid in recalls by giving each item a unique identifier by authenticating use of a product to prevent tampering. Consumer interest in transparency and traceability is growing; a recent study found that 71% of consumers would be willing to pay a premium of 37% for more information on the origin of products and ingredients.[13]

PERSONALIZED CONSUMER SAFETY AND ADVANCED PRODUCT TESTING

With enough data, AI can be used to analyze and tailor safety recommendations based on a person's preferences, health state, and usage patterns.[14]

Potential Applications. Personalized consumer safety will be particularly applicable to the medical industry. Companies are currently designing medical devices and machine learning models that can evolve based on the needs of an individual patient. For example, AI could be used to do a cost-benefit analysis on a medication with potentially serious side effects. AI is also being used on existing large datasets of health data to analyze and identify trends faster than humans can.[15]

Challenges. Organizations are still adjusting to the paradigm shift introduced by AI and other automation technologies. Some organizations have had difficulty choosing and implementing the infrastructure needed to handle personalized safety technologies.[16]

TOY SAFETY FOCUSING ON SUSTAINABLE AND NON-TOXIC MATERIALS

Investments in toy safety testing have been growing as toy creators prioritize the use of safer and more sustainable materials. For decades, ASTM standards have been relied upon to ensure that toxic chemicals and heavy metals are removed or inaccessible to children's toys. These ASTM standards will continue to play a pivotal role as new and emerging hazards are identified in future products that enter the marketplace. [17]

Health and Safety
Consumer Safety

EMERGING EMPHASIS ON SUSTAINABILITY AS A COMPONENT OF CONSUMER SAFETY

Today's increased focus on sustainability of products has created an opportunity for standards to fill gaps in the marketplace.[18]

Goals for Safe and Sustainable Product Design. Safe and sustainable product design will include minimizing use of hazardous chemicals, reducing greenhouse gas emissions, and looking for ways to reuse and recycle materials using circular economy practices.[19]

Challenges to Safe and Sustainable Product Design. Introducing circular economy practices creates additional opportunities for the adoption of standards. Mitigating legacy substances such as lead, polychlorinated biphenyls (PCBs), and decabromodiphenyl ether (DacBDE) is one of the challenges facing the circular economy, and standards can play a role in overcoming it.[20]

ASTM IMPACT ACTIVITY Collaboration between Juvenile Product Manufacturers Association (JPMA) and Amazon		ASTM standards for juvenile products are the basis for a robust product certification program developed and managed by JPMA. Through collaboration with Amazon and JPMA, Amazon sellers can submit their JPMA certification as proof that their juvenile products meet ASTM standards and mandatory requirements at the federal and state levels.
ASTM IMPACT ACTIVITY Global Alliance to Eliminate Lead Paint		ASTM joined the Global Alliance to Eliminate Lead Paint, a voluntary partnership formed by the United Nations Environment Programme (UNEP) and the World Health Organization (WHO), to prevent exposure to lead by promoting the phase-out of paints containing lead. Read story.
ASTM IMPACT ACTIVITY Collaboration with the International Consumer Product Health and Safety Organization (ICPHSO)		ICPHSO is an international, neutral forum for product safety stakeholders to learn, network, and share information. ASTM staff and members contribute to the engagement with ICHPSO in various capacities and have leadership roles in which they assist to determine basic policies and set goals and objectives. Read story.
ASTM IMPACT ACTIVITY European Chemicals Agency (ECHA) PFAS Restriction Proposal		ASTM International submitted comments during the public consultation period highlighting our portfolio of existing and in-progress standards on PFAS.
ASTM IMPACT ACTIVITY ASTM webinar on the F2057-23 Standard Safety Specification for Clothing Storage Units (CSUs)		ASTM hosted a webinar to provide insights into strategies for compliance and best practices with its F2057-23 standard which establishes stability requirements that reduce the risk of clothing storage unit tip-over. The standard was adopted as a U.S. Consumer Product Safety Commission (CPSC) mandatory rule with an effective date of September 1, 2023.
RELEVANT ASTM STANDARD (HIGH IMPACT) Consumer Safety Specification for Full-Size Baby Cribs	F1169	This consumer safety specification establishes the performance requirements and test procedures to determine the structural integrity, design requirements addressing entanglement on corner post extensions, and requirements for warning labels and instructional material for full-size baby cribs.

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RELEVANT ASTM STANDARD (HIGH IMPACT) Practice for Ownership, Operation, Maintenance, and Inspection of Amusement Rides and Devices	F770	The purpose of this practice is to delineate information and to establish procedures for operation, maintenance, inspection, and training for amusement rides and devices.
RELEVANT ASTM STANDARD Standard Guide for PFAS Analytical Methods Selection	E3302	This guide provides an overview of analytical methods, techniques, and procedures that may be used in determination of PFAS in environmental media.
RELEVANT ASTM STANDARD Standard Consumer Safety Specification for Toy Safety	F963	This specification relates to possible hazards that may not be recognized readily by the public and that may be encountered in the normal, intended use of a toy or after reasonably foreseeable abuse.
RELEVANT ASTM STANDARD Standard Consumer Safety Specification for Recreational Powered Scooters and Pocket Bikes	F2641	This new standard establishes performance requirements, test methods, and marking requirements to promote safe use of recreational powered scooters and pocket bikes intended for use by children age eight to twelve years, and adolescents age thirteen and above. This consumer safety specification is intended to minimize the risk of injury to an occupant from the normal use and reasonably foreseeable misuse of these e-mobility products.
RELEVANT ASTM STANDARD Standard Consumer Safety Specification for Beach Umbrellas and Anchor Devices	F3681	This standard establishes performance requirements for beach umbrella/anchor systems to prevent the beach umbrella/anchor system from detaching from the sand.
RELEVANT ASTM STANDARD Standard Safety Specification for Clothing Storage Units	F2057	This safety specification is intended to reduce injuries and deaths of children from hazards associated with tip-over of clothing storage units, it covers chests, drawer chests, chests of drawers, dressers, and bureaus.
RELEVANT ASTM STANDARD Standard Specification for Glycol-Based Coolants for Fuel Cell Electric Vehicles	D8565	This specification covers the requirements for fully formulated glycol-based coolants used in a fuel cell electric vehicle (FCEV).
RELEVANT ASTM STANDARD Standard Guide for Ensuring the Safety of Connected Consumer Products	F3463	This standard provides guidelines for ensuring the safety of consumer products that are connected to the internet or other networks. It outlines best practices and considerations for manufacturers, designers, and other stakeholders to address potential safety risks associated with connectivity, such as cybersecurity threats, data privacy concerns, and physical hazards. The guide aims to help ensure that connected consumer products are safe for use, comply with relevant regulations, and protect the well-being of users.
RELEVANT ASTM STANDARD Standard Specification for Glycol-Based Electric Vehicle Coolant with Low Electrical Conductivity	D8566	This specification covers fully formulated glycol-based coolants with low electrical conductivity for use in electric vehicles (EV).

Health and Safety
Consumer Safety

STANDARD IN PROGRESS Standard Guide for PFAS Data Evaluation Guidance	WK76460	This proposed guide covers several critical aspects for assessing, evaluating, and interpreting PFAS data received from analytical laboratories: project planning, data quality assessment, data usability, and ultimately, data validation and evaluation.
STANDARD IN PROGRESS New Test Method for Total Organic Fluorine (TOF) in Solid Matrices by Solvent Extraction followed by Combustion Ion Chromatography (CIC)	WK90492	This proposed test method is intended to provide a method to detect and quantify PFAS in consumer products. It covers the determination of total organic fluorine (TOF) in solid matrices by solvent extraction followed by combustion ion chromatography and measures compounds containing organic fluorine readily leached or soluble under the conditions of the extraction.
STANDARD IN PROGRESS Standard Specification for Nursing Pillows	WK82241	This proposed consumer safety specification establishes safety performance requirements, test methods, and labeling requirements to minimize the hazards to infants presented by nursing pillows.
STANDARD IN PROGRESS New Specification for Commercial Electric-Powered Scooters for Adults	WK70724	This proposed consumer safety specification covers the establishment of performance requirements and corresponding test methods used to minimize the hazards of users of commercial electric-powered scooters for adults.
STANDARD IN PROGRESS New Test Method for the Determination of Conductive Deposits of Electrical and Mechanical Components from fluids in Liquid and Vapor States within an Electrically Charged System	WK82348	This proposed test method quantitatively measures the rate of corrosion in copper exposed to test fluids at various temperatures. Both liquid and vapor exposure is included in this test method.
STANDARD IN PROGRESS New Test Method for the Determination of Wire Corrosion and Oxidation from Fluids in Liquid and Vapor States Within an Electrically Charged or Mechanical System	WK87553	This proposed test method covers the basic operation of the Wire Corrosion Test, which is used to monitor the corrosiveness of the test fluid by monitoring changes in resistance in the wires under test. The general test represents the degree of protection an oil has on the bare copper connective wire, or other conductive material, in automatic transmission gearbox systems or other industry applications.
STANDARD IN PROGRESS New Practice for Container Availability	WK87207	This new practice is to establish a logical, harmonized industry “best practice” that will enable seamless communication of container availability across global supply chains. The “best practice” is expected to involve a unique digital load identifier, linked with associated transport units (e.g., containers), as well as some technical specifications to ensure consistent implementation and interoperability across the actors in the relevant supply chain activities.

Health and Safety
Medical and Surgical Devices

Various technological innovations are poised to transform medical care in the coming decades. Patients are increasingly utilizing wearable and portable health monitoring devices that can provide physicians with additional patient health information to aid in diagnosis and decision-making. Robotics-aided surgeries are also on the rise, enabling surgeons to perform surgeries remotely and with greater precision, consistency, and dexterity. Various other advanced health technologies under development have the potential to greatly enhance patient care, including medical exoskeletons, AI-enhanced medical imaging and diagnosis, nanorobotics, and 3D printing of implants and medical supplies.

FUTURE OF MEDICAL AND SURGICAL DEVICES

ASTM NEWS STORIES

- Standards Improve Medical Device Manufacturing
- Powder Bed Fusion in Medical Device Manufacturing
- Cleaning Agent Formula for Medical Devices
- A Partnership to Help Prevent Infection
- Cardiovascular Medical Devices
- Standards and 3D Printing Human Tissue
- Orthopedic Locking Mechanisms

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3 GOOD HEALTH AND WELL-BEING
10 REDUCED INEQUALITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION

HEALTH MONITORING DEVICES WILL PROVIDE MEDICAL INSIGHTS

Use of Health Monitoring Devices is Increasing. More people are using wearable or portable electronic devices—including watches, jewelry, clothing, and other body attachments—to monitor health and physical activity.[21]

Health Monitoring Devices Provide Real-time Information to Inform Medical Decisions. Smart devices and wearable biosensors can non-invasively provide information about patient vitals and physical activity and can provide data to support medical predictions, detect anomalies, and potentially make earlier diagnostic and treatment decisions.[22, 23]

Machine Learning Can Help with Interpretation of Data from Health Monitoring Devices. Machine learning, a subset of artificial intelligence, has emerged as a major tool for interpreting health monitoring data and making predictions from patterns about potential future patient scenarios (e.g., measuring the progression of Alzheimer's through gait tracking and analysis).[24, 25, 26]

Standards Will Be Needed to Safeguard Patient Data. As healthcare becomes more digital in nature, stewardship standards will be needed to promote trust and ensure medical data are securely managed and protected.[27]

ROBOTICS WILL AID OR AUGMENT MORE SURGERIES

Medical robotics can allow surgeries to be more precise and less invasive.[28]
In addition, advances in 5G-enabled telecommunications allow increased speeds and lower latencies of long-distance robotic-assisted surgery, which will make remote surgeries possible for patients who are unable to easily travel to a qualified surgeon.[29]

MEDICAL EXOSKELETONS WILL HELP SUPPORT PHYSICAL THERAPY, INDEPENDENCE, AND QUALITY OF LIFE

Exoskeletons will increasingly support physical therapy and help patients restore range of motion following surgeries or injuries. These devices could also reduce the number of medical professionals needed to care for individual patients.[30]

Health and Safety
Medical and Surgical Devices

AI WILL HELP DOCTORS IDENTIFY TRENDS AND PATTERNS UNDETECTABLE TO HUMANS

AI-driven analytics are increasingly being incorporated into medical imaging to advance medical screenings, analyze risk factors, and detect abnormalities, which can augment decision-making and reduce diagnostic errors.[31,32] AI also has the potential to cut treatment costs by up to half while significantly improving patient outcomes.[33]

NANOROBOTICS COULD TRANSFORM DIAGNOSIS AND DRUG DELIVERY

Nanorobotics are under development that could be used to treat cancer and other serious conditions by navigating through the body to directly administer medicine or therapy to a targeted area (e.g., hard-to-reach tumors).[34,35] Nanorobots could provide personalized and combination treatments such as imaging agents that act as drugs or surgery with immediate diagnostic feedback. Treatments using nanorobots would be less invasive than surgery and could minimize unwanted side effects from medicines by better targeting them to the correct place in the body.[36]

3D-PRINTED MEDICAL DEVICES AND IMPLANTS

AM applications include customized implants (blood, tissue, and blood vessels), prosthetics, medical models, dental devices, hearing aids, and other medical devices.[37]

3D-Printed Organs. 3D printed models of organs can help surgeons prepare different treatment options and assess surgical risks.[38] While full working bio-printed organs are not yet possible, improvements are expected in the field to ultimately enable development of transplantable organs that could offset donor organ supply issues.[39]

3D-Printed Medical Supplies. AM technologies offer decentralized production of medical supplies such as screening tools, which could help alleviate supply chain issues in the medical industry.[40]

ASTM IMPACT ACTIVITY New ASTM Subcommittee on Sustainable Healthcare	E60.42	ASTM's new sustainable healthcare subcommittee encompasses healthcare facilities, procedures, products, and their associated lifecycles. The standards developed by this committee will consider the applicable regulatory requirements in terms of how they constrain sustainability options for facilities, suppliers, and services in the healthcare sector.
RELEVANT ASTM STANDARD Standard Practice for Measurement of Positional Accuracy of Computer-Assisted Surgical Systems	F2554	This standard provides data that can be used for evaluation of the accuracy of different computer-assisted surgical (CAS) systems.

Health and Safety
Medical and Surgical Devices

STANDARD IN PROGRESS New Guide for Fatigue Strength Characterization of Components, Coupons, and Surrogates for Metallic Cardiovascular Medical Devices	WK88773	This proposed guide would aid users in the fatigue strength determination of their device material in its final, finished form so as to enable accurate fatigue assessments.
STANDARD IN PROGRESS New Test Methods for Locking Mechanisms for Locking Plate and Screw Systems	WK88483	The proposed test methods will evaluate and compare the mechanical properties of locking mechanisms used with locking plate and screw systems.
STANDARD IN PROGRESS Standard Guide for Designing for Recyclability of Single-Use Medical Products and Packaging	WK88282	This proposed guide provides direction for the design of single-use medical products and packaging for recycling. The package materials must be selected appropriately to enable the product to be recycled.

Health and Safety
Personal Protective Equipment (PPE)

There are many drivers that have prompted a significant increase in demand for personal protective equipment (PPE) globally, with the recent COVID-19 pandemic being just one. PPE is often single-use and can contribute significantly to plastic pollution in landfills and the sea.

FUTURE OF PERSONAL PROTECTIVE EQUIPMENT (PPE)

ASTM NEWS STORIES

- ASTM International Approves Face Covering Standard, Releases PPE White Paper
- PPE Efforts Accelerate
- Standards in a Pandemic: When PPE Jumped into the National Spotlight
- A Forum to Promote PPE Around the Globe
- Standards Behind the Mask
- Standards for Medical Face Masks and Protective Clothing
- Outreach: Building Relationships: IFC and ASTM International Sign Memorandum of Understanding for Global PPE Activity
- Barrier Face Covering Standard
- Fabrics for High Risk Environments
- Case Study on Standards: Barrier Face Coverings
- New Test Method Will Evaluate Effectiveness of Antimicrobial Wipes

ADDITIONAL RESOURCES

- Global Collaboration to Advance Personal Protective Equipment (PPE) Safety, Quality, and Innovation White Paper
- ASTM Response to COVID-19 – Design for Additive Manufacturing

MARKET GROWTH

The global PPE market grew from $71B in 2021 to $80B in 2022 and is projected to reach nearly $111B by 2029.[41]

ENVIRONMENTAL IMPACTS OF SINGLE-USE PPE

The COVID-19 pandemic increased the demand for single-use PPE, which resulted in a surge of plastic pollution. As of August 2021, more than 8.4M tons of COVID-19-related plastic waste and PPE (including face shields, masks, and gloves) had been created.[42] According to one estimate, approximately 129B disposable masks and 65B disposable gloves were used every month during the COVID-19 pandemic.[43] Currently, there is no infrastructure for environmentally friendly disposal of potentially contaminated face masks.[44] The United Nations estimates that approximately 75% of pandemic-related plastic waste will end up in landfills or the sea.[45]

POTENTIAL TO INCREASE PPE SUSTAINABILITY

The development of biodegradable protective clothing and PPE could reduce their environmental impact.[46] Additionally, an increasing number of manufacturers are developing reusable PPE for consumers (e.g., face masks) and medical professionals (e.g., gowns, coveralls).[47] Reusable medical garments, which can be laundered dozens of times, can provide hospitals with a 50% cost reduction in gown expenditures.[48]

SMART PPE CAN PROVIDE HEALTH AND SAFETY INFORMATION

There is growing interest in "smart PPE" wearable devices for improving workplace safety while capturing physiological data.[49] Washable, durable, and flexible graphene-based wearable e-textiles could be integrated into protective clothing to gather information such as heart rate, breathing rate, and temperature.[50]

AVOIDING FUTURE PPE SUPPLY CHAIN SHORTAGES

The COVID-19 pandemic resulted in significant PPE supply shortages related to increases in demand and activities such as hoarding, panic buying, and improper use.[51] New Industry 4.0 manufacturing technologies such as robotics, AM, and AI could help prevent similar supply chain issues in the future by enabling cost-effective manufacturing of PPE at scale.[52]

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Health and Safety
Personal Protective Equipment (PPE)

ASTM IMPACT ACTIVITY Global Collaboration Forum for Personal Protective Equipment (PPE)		This forum was a collaborate agreement, such as a memorandum of understanding, among various SDOs and other key stakeholders to identify and fill critical needs. The goal was to establish a common, shared workspace, enabled by and offering digital tools to facilitate collaborative activities and interorganizational communication. Learn more.
ASTM IMPACT ACTIVITY Memorandum of Understanding (MoU) between ASTM International Finance Corporation (IFC)		Under the MoU, ASTM International and IFC, a member of the World Bank Group, worked together to develop and disseminate knowledge on standards for personal protective equipment (PPE) and compliance requirements globally. Learn more.
ASTM IMPACT ACTIVITY ASTM International and Jordan Standards and Metrology Organization (JSMO) Conduct Training Under the International Finance Corporation (IFC) Global Advisory Program on Personal Protective Equipment (PPE)		As part of this MoU, ASTM delivered a series of procedural and technical programs for Jordan. The monthly technical webinars enabled public and private sector stakeholders to better understand standards for medical and non-medical PPE including masks, gowns, gloves, and related products such as sanitizers. Learn more.
RELEVANT ASTM STANDARD (HIGH IMPACT) Standard Specification for Barrier Face Coverings	**F3502**	This specification is intended to help ensure barrier face coverings meet the stated requirements and provide (1) a means of source control for individual wearers by reducing expelled aerosols from the wearer's nose and mouth into the air; and (2) a degree of particulate filtration that potentially reduces the amount of aerosols inhaled by the wearer.
RELEVANT ASTM STANDARD Standard Specification for Performance of Materials Used in Medical Face Masks	**F2100**	This specification covers testing and requirements for materials used in the construction of medical face masks that are used in providing healthcare services such as surgery and patient care.
RELEVANT ASTM STANDARD Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X174 Bacteriophage Penetration as a Test System	**F1671**	This test method is based on F903 which measures resistance of chemical protective clothing materials to penetration by liquids. This test method is normally used to evaluate specimens from individual finished items of protective clothing and individual samples of materials that are candidates for items of protective clothing.
RELEVANT ASTM STANDARD Standard Guide for Home Laundering Care and Maintenance of Flame Resistant or Arc Rated Clothing	**F2757**	This guide is intended for use by employees of the end user, such as safety personnel or program administrators, who have chosen to implement a home-laundered flame-resistant or arc-rated clothing program.

Health and Safety
Personal Protective Equipment (PPE)

RELEVANT ASTM STANDARD Standard Specification for Isolation Gowns Intended for Use in Healthcare Facilities	F3352	This specification establishes minimum requirements for the performance and labeling of isolation gowns intended for use by healthcare workers to provide protection for standard and transmission-based precautions.
RELEVANT ASTM STANDARD Standard Test Method for Quantitative Performance Evaluation of Antimicrobial Towelettes	E3363	This test method quantitatively determines the effectiveness of various sizes of antimicrobial towelettes in treating hard, non-porous surfaces against *Pseudomonas aeruginosa* and *Staphylococcus aureus*.

Health and Safety
End Notes/References

CONSUMER SAFETY

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