FIP knowledge & skills reference guide for professional development in environmental sustainability

2025

Colophon

International Pharmaceutical Federation (FIP)
Andries Bickerweg 5
2517 JP The Hague
The Netherlands
www.fip.org

Authors:
Rafa AlKhalifa, FIP SustainabilityRx Programme intern
Ruben Viegas, FIP Humanitarian and Sustainability Programme Manager

Editor:
Dalia Bajis, Head of Programmes and Provision

Recommended citation:
International Pharmaceutical Federation (FIP). Knowledge & skills reference guide for professional development in environmental sustainability. The Hague: FIP; 2025.

Cover image:
SeizaVisuals | istockphoto.com

Contents

1 Acknowledgements

FIP and the authors acknowledge members of the reference group whose names are listed below for their valuable comments and suggestions on this guide.

Name of reviewer	Affiliation	Country
Chima Amadi	CEO and founder, Clemac Digital Health; FIP DG 21 Lead	Nigeria
Naoko Arakawa	Associate Professor, School of Pharmacy, University of Nottingham	UK
Hayley Blackburn	Associate professor, University of Montana Skaggs School of Pharmacy & Rx for Climate	USA
Min Na Eii	Advanced pharmacist practitioner, South Tyneside and Sunderland NHS Foundation Trust	UK
Lizette Ezenekwe	Lecturer in clinical pharmacy, Nnamdi Azikiwe University, Awka; FIP DG 21 Lead	Nigeria
Nuala Hampson	Lead facilitator, Centre for Sustainable Healthcare	UK
Tarek Hussein	Director of Content, Canadian Association of Pharmacy for the Environment (CAPhE)	Canada
Marc-André Mailhot	CEO, Maillon Vert	Canada
Kate O'Hara	Vice-president, Advanced Pharmacy	Australia
Pascale Salameh	Founder and director, INSPECT-LB	Lebanon
Duaa Mohamed Suliman	Research Fellow, Mohamed Bin Rashid School of Government	UAE
Laura Wilson	Director for Scotland, Royal Pharmaceutical Society	UK

2 Background

2.1 Pharmacy professionals' role in climate, planetary health, and sustainable development

Pharmacists are uniquely positioned to lead efforts in reducing the environmental impact of pharmaceuticals and promoting sustainability across healthcare systems. While research demonstrates that pharmacists recognise climate change as a significant health threat, many lack clarity about their specific role in addressing these challenges. This knowledge gap presents both an opportunity and an imperative for educational reform. A Canadian study[1] revealed that 91% of pharmacy students plan to advocate for sustainable practices in their future careers, highlighting strong motivation for environmental stewardship. These findings align with international research showing pharmacy students' strong desire for comprehensive sustainability knowledge and training.

Healthcare increasingly contributes to the climate crisis, with greenhouse gas emissions related to healthcare globally rising by 36% since 2016.[2] Both hospitals and pharmaceuticals are identified as having the largest carbon footprints collectively, accounting for 63% of healthcare emissions.[3] As an example of the impact the pharmaceutical sector's significant environmental footprint, in the UK alone it is responsible for 4.4% of global greenhouse gas emissions and contributes to 25% of National Health Service (NHS) emissions, demanding urgent professional action.[1, 2]

Pharmacists occupy a critical position in addressing climate change and environmental sustainability within healthcare systems. These actions contribute directly to FIP Development Goal 21 (Sustainability in Pharmacy) in supporting global sustainability objectives. FIP's Statement of Policy on Environmental sustainability within pharmacy (2023) and Statement of Policy on Environmentally sustainable pharmacy practice (2016) affirm the profession's responsibility to mitigate environmental harm and foster climate-resilient health systems.

Pharmacists and pharmacy teams are uniquely positioned to integrate both mitigation strategies (reducing emissions, preventing pollution, and embedding sustainable practices) and adaptation strategies (ensuring climate-resilient services that maintain quality and accessibility, particularly resource-limited settings).[2] These strategies must also address the intersection between environmental sustainability, health equity, affordability, and universal access.

This guide encompasses both dimensions: Mitigation efforts focused on reducing environmental impact through greenhouse gas emissions reduction, pollution prevention, and sustainable practice implementation, and adaptation strategies centred around developing climate-resilient healthcare services that maintain accessibility and quality despite environmental challenges. This guide emphasises the intersection points between environmental sustainability, health equity, affordability, workforce development, and resource accessibility.

The guide is intended for pharmacists, educators, policymakers, regulators, industry stakeholders, and healthcare leaders involved in shaping, delivering, or governing pharmacy services, ensuring that the environmental agenda in pharmacy also supports patient care, community well-being, and universal health coverage.

By providing a basis on sustainability-related knowledge and skills, this guide supports professional development, upskilling, and refreshing knowledge and skills for environmentally responsible healthcare delivery. It demonstrates how pharmacists across diverse settings can implement sustainability principles within their roles, while advancing FIP's global sustainability goals through sector-specific, actionable strategies.

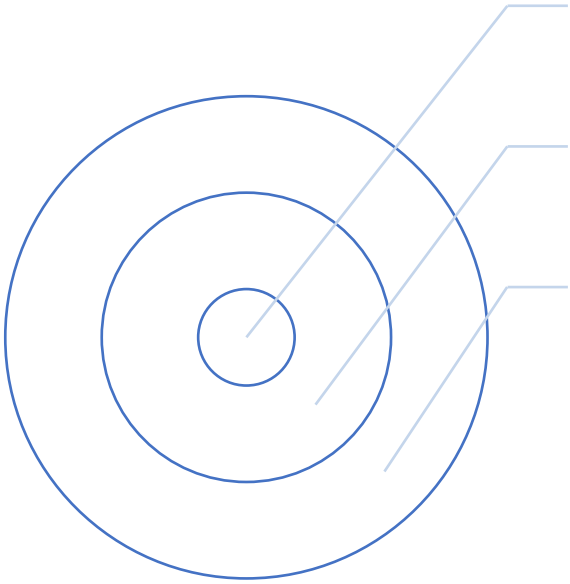
2.2 Guidance for users

This guide supplements existing FIP resources and was informed by a reference group of educators and practitioners with expertise in environmental health, sustainable pharmacy practice, and professional development, that reviewed and validated the content to ensure accuracy and applicability. The methodology integrates current research evidence with practical implementation strategies, drawing on studies that demonstrate both healthcare cost benefits of continuity of care, and the critical role of activated, informed consumers in improving healthcare quality. This approach emphasises patient participation as effective members of the care team while incorporating environmental stewardship principles.[4, 5]

Structure of the K&S guide

The guide is structured around sustainability-related knowledge and skills, grouped into three broad categories, as shown in Figure 1:

Figure 1 - Organisation of the K&S guide on environmental sustainability



Specialised (advanced topics): These build on the core areas and reflect advanced knowledge or applications.

Core topics: These outline the essential knowledge and skills that pharmacists should develop in relation to sustainable pharmacy practice, focusing on both mitigation and adaptation roles.

Broad topic areas: These represent the overarching domains of sustainability in pharmacy, such as environmental stewardship, climate-resilient practice, public health advocacy, capacity building, and interprofessional collaboration.

This guide is designed to support pharmacists and pharmacy teams in developing sustainability-related knowledge and skills as part of their ongoing professional development. It also serves as a resource for those seeking to integrate environmental considerations into their specific areas of practice.

Key considerations for the users of this guide:

- **Distinction between core and advanced knowledge**
  - Core: Basic, essential knowledge and skills related to sustainability that pharmacists should possess.
  - Advanced: Specialised, in-depth-knowledge intended for those in leadership, research, or policy roles.
- **Distinction between practice-based and manufacturing aspects**
  - Identifying which knowledge areas or actions are most relevant to clinical practice and which apply primarily to the industrial pharmacy context.
- **Distinction between the needs of educators and policy-makers**

- Certain elements of the guide are tailored for academic trainers and educators, while others are directed toward policymakers and regulators, acknowledging their differing roles and responsibilities.

Disclaimer: Contextualisation and regulatory requirements

Pharmacy professionals must adhere to their local, national, and jurisdictional requirements for training, certification, and regulatory/professional standards when applying sustainability practices. Implementation must comply with existing pharmaceutical regulations while promoting environmental stewardship within legal and ethical boundaries.

It is recognised that pharmacists will be at different stages of their career development, and that essential and specialised knowledge and skills may overlap or evolve over time. This guide is therefore intended to be flexible and adaptable to diverse professional contexts.

Additional considerations may include:

- Undertaking appropriate training relevant to scope of practice and level of specialisation in environmental health and sustainable pharmacy practice.
- Following professional codes of conduct that may address environmental responsibilities.
- Completing nationally developed certificate programmes or specialised training in sustainability or environmental health.
- Maintaining current registration or licensure status.
- Engaging with professional associations that focus on sustainability in healthcare.
- Complying with healthcare jurisdiction laws governing education, competencies, and environmental responsibilities of pharmacy and other health professionals.

2.3 Glossary of key concepts and definitions

Term	Definition	Reference
Active Pharmaceutical Ingredient (API) environmental persistence	APIs, particularly antibiotics, persist in treated wastewater and sludge, contributing to antimicrobial resistance development, and contaminating surface waters and agricultural land, necessitating comprehensive environmental risk assessment and management strategies.	6
Adaptation in pharmacy	Refers to measures that support the health of individuals and communities affected by climate change and ecological crises. This includes ensuring equitable access to medicines, optimising treatment to minimise environmental impact, and equipping pharmacy professionals to respond to climate-related health challenges such as extreme heat, flooding, natural disasters, and the management of chronic diseases under changing conditions, all while ensuring the continuity of pharmacy services in vulnerable and resource-limited settings under climate-related stressors.	7
Basel Convention	International treaty controlling transboundary movement of hazardous waste, particularly preventing waste transfers from developed to developing nations, whilst ensuring environmentally sound waste management practices.	8
Carbon emissions	The release of carbon dioxide (CO_2) into the atmosphere, primarily from burning fossil fuels like coal, oil, and natural gas for energy, transportation, and industry.	9
Circular economy in healthcare (circular healthcare)	A shift from the linear "take–make–dispose" model to a regenerative system that minimises new material and energy inputs, reduces environmental pressures, and maintains the highest value of materials and products. Implementation involves recycling, efficient resource use, renewable energy, remanufacturing, refurbishment, reuse, product life extension, product-as-a-service models, sharing, and waste prevention by design, alongside phasing out landfill and incineration.	10
Controlled substance security	Proper substance management prevents diversion for illicit use while preventing environmental contamination through poorly managed disposal sites that enable scavenging and re-sale of expired medications, creating both public health and environmental hazards.	11

Environmental impact management	Pharmaceuticals affect environmental health throughout their lifecycle from production and transportation (generating significant greenhouse gas emissions) to disposal challenges including improper waste management that releases harmful chemicals like dioxins and furans into air, soil, and water systems.	12
Environmentally Sustainable Pharmacy Practice (ESPP)	A statement of the FIP Green Pharmacy Policy (2016) calling for the integration of environmental responsibility into all aspects of pharmacy education, research, manufacturing, distribution, prescribing, dispensing, use, and disposal of medicines. It emphasises minimising the ecological and health impacts of pharmaceuticals across their lifecycle by promoting rational medicine use, safe waste management, eco-conscious operations, and patient education. ESPP shifts pharmacy practice towards safeguarding planetary health while ensuring the safe and effective care of patients.	13
Extended Producer Responsibility (EPR)	An environmental policy approach that makes producers responsible for the entire lifecycle of their products, including post-consumer waste management. It is built on four main pillars: the duty of preventing pollution, the life cycle concept, the polluter-pays principle, and the internalisation of costs. Through EPR, the burden of waste management shifts from municipalities and taxpayers to producers, creating incentives for sustainable product design, responsible waste handling, and reduced environmental and health impacts.	14
Greenhouse gases (GHGs)	Gases that trap heat in the Earth's atmosphere, contributing to the greenhouse effect and climate change. The Kyoto Protocol cover emissions of the six major GHGs, namely: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulphur hexafluoride (SF6).	15
Life Cycle Assessment (LCA) of pharmaceuticals	A methodological framework used to evaluate the potential environmental impacts of products, technologies, or services across their entire life cycle—from raw material extraction and manufacturing through distribution, use, and end-of-life (disposal, recycling, or waste treatment). It involves four iterative phases: goal and scope definition, life cycle inventory, impact assessment, and interpretation. By taking a full life cycle perspective, LCA helps avoid shifting environmental burdens from one stage or impact category to another.	16
Mitigation in pharmacy	Reducing pharmaceutical pollution and climate impact by minimising medicine waste, ensuring proper disposal, lowering emissions from healthcare, medicine production and use, and strengthening the pharmacist's role in all four principles of sustainable healthcare: preventive care; patient self-care; lean service delivery; and low carbon alternatives alongside healthcare quality, particularly in high-emission countries.	17
Net zero commitments	A balanced state achieved when greenhouse gas emissions released into the atmosphere equal the amount extracted or offset, creating no overall increase in global emissions. Reaching net zero requires comprehensive emission reduction strategies combined with carbon removal investments such as reforestation initiatives or carbon capture technologies, with implementation targets focused on this decade to constrain global temperature rise to 1.5°C or 2°C above pre-industrial baseline levels.	18
PharmEcovigilance	The holistic assessment system extends the concerns of traditional pharmacovigilance to include the adverse environmental impacts of medicines.	19
Planetary health	A transdisciplinary field and movement focused on understanding and addressing how human disruptions to Earth's natural systems affect human health and all life. It seeks innovative, cross-sector solutions to guide responsible stewardship of the planet and safeguard both environmental and human well-being.	20
Porogenic solvents	Eco-friendly solvents and ionic liquids that replace conventional solvents by dissolving specific components during synthesis, then being removed via evaporation, leaching, or phase separation to create controlled porous structures. These "pore-generating" solvents combine environmental sustainability with functional advantages, enabling precise porosity control in pharmaceutical applications while reducing chemical waste and toxicity compared to traditional solvent systems.	21

Stockholm Convention	Global treaty eliminating or restricting Persistent Organic Pollutants (POPs) and toxic chemicals that persist in the environment, bioaccumulate in organisms, and pose significant health risks requiring international cooperation for effective control.	22
Waste classification and management	Healthcare waste comprises 75-90% non-hazardous general waste and 10-25% hazardous materials including sharps, infectious waste, pathological waste, pharmaceutical waste (including genotoxic substances), chemical waste, and radioactive materials, each requiring specialised handling protocols.	23

3 Alignment with existing FIP frameworks

The FIP Global Competency Framework (GbCF) and the FIP Global Advanced Development Framework (GADF) provide essential foundations for the development of a pharmacy workforce equipped to meet contemporary healthcare challenges, including environmental sustainability and system resilience. These frameworks emphasise continuous professional development, the advancement of knowledge and skills, and the cultivation of competencies that transcend specific roles or settings.

Sustainability-related competencies are closely linked to the four broad clusters of the GbCF:

1. Pharmaceutical public health
2. Pharmaceutical care
3. Organisation and management
4. Professional and personal competencies.

They also align with the FIP Development Goals (FIP DGs), particularly those focused on **sustainability (DG 21), equity (DG 10), and competency development (DG 5).**

To embed sustainability meaningfully into pharmacy practice, pharmacists must demonstrate a set of cross-cutting competencies that apply across all sectors, ensuring both patient well-being and environmental stewardship.

At the heart of sustainable pharmacy practice lies the concept of 'holistic thinking' (circular reasoning),[10] defined as the ability to see the bigger picture, understand interconnections, and anticipate the wider impacts of actions on both human and planetary health. Holistic thinking is essential for:

- Recognising the links between medicine use, healthcare practices, supply chains, and environmental outcomes.
- Designing solutions that avoid unintended consequences such as overuse, waste, or resource depletion.
- Balancing individual patient needs with population health, ecological and business sustainability.

Without holistic thinking, sustainability efforts risk becoming fragmented and ineffective. This competency enables pharmacists to act as catalysts, integrators and leaders in the challenging and complex healthcare systems. By fostering such competencies, pharmacists can position themselves as leaders in advancing sustainable healthcare systems, reducing the environmental footprint of pharmaceutical services, and safeguarding both population and planetary health.

Examples of sustainability-related competencies within the GbCF clusters are outlined below:

Area	GbCF Cluster	Description	Sustainability link
 Emergency response	Pharmaceutical Public Health	Competency in responding to public health emergencies, natural disasters, and crises by supporting continuity of pharmaceutical care and ensuring resilience of supply chains.	Environmental: Maintains resilient supply chains during disasters, avoiding wastage of medicines and resources. Social: Protects access to care for vulnerable populations. Economic: Reduces costs from disruptions.

 Monitor medicines therapy	Pharmaceutical Care	Applying therapeutic guidelines, monitoring medication effectiveness and safety, and supporting the optimisation of medicine use. This competency plays a vital role in reducing unnecessary treatments, preventing waste, and improving patient and environmental outcomes.	Environmental: Minimises pharmaceutical waste and pollution through rational medicine use and adherence. Social: Enhances patient safety and outcomes. Economic: Avoids costs from inappropriate or duplicated treatments.
 Procurement	Organisation & Management	Applying sustainable procurement practices to ensure cost-effective, ethical, and environmentally responsible sourcing of medicines and health products. This competency contributes to reducing waste and supporting access.	Environmental: Promotes eco-friendly and ethical sourcing of medicines, reducing carbon footprint and waste. Social: Ensures equitable and ethical access. Economic: Supports cost-effective purchasing.
 Supply chain management	Organisation & Management	Ensuring the efficient, transparent, and sustainable management of pharmaceutical supply chains, including inventory control, waste reduction, and contingency planning to mitigate shortages. This is key to maintaining both service quality and strengthening environmental supply chain resilience.	Environmental: Reduces overstocking, waste, and emissions through efficient logistics. Social: Guarantees continuity of access. Economic: Prevents economic loss from shortages and expired stock.
 Professional and ethical responsibility	Professional & Personal	Upholding ethical practice that considers environmental, social, and public health impacts alongside individual patient needs. This includes adopting socially accountable and culturally sensitive approaches.	Environmental: Encourages environmentally responsible decisions in care delivery. Social: Integrates equity, cultural sensitivity, and accountability. Economic: Supports responsible resource use.
 Behavioural change communication	Pharmaceutical Care / Public Health	Applying health literacy principles, motivational interviewing, and culturally competent communication to support patients in adopting healthier and more sustainable behaviours. This aligns with both pharmaceutical care and public health competencies.	Environmental: Promotes sustainable behaviours (e.g., correct disposal, reduced overuse of medicines). Social: Improves health literacy and lifestyle choices.

			Economic: Reduces system burden and future costs.
 Digital literacy for sustainability	Professional & Personal	Proficiency in using digital technologies, data systems, and health informatics to drive environmentally sustainable practices, improve efficiencies, and enhance patient care. Digital literacy is recognised as a core competency in the GbCF.	Environmental: Cuts paper use, improves resource efficiency, and lowers the carbon footprint through digital systems. Social: Enhances services availability, patient access and connectivity. Economic: Improves efficiency and reduces operational costs.
 Interprofessional collaboration	Cross-cutting	The ability to work effectively within multidisciplinary teams to co-create solutions for complex health and sustainability challenges. This competency underpins integrated care delivery and is central to both the GbCF and GADF.	Environmental: Enables joint solutions to sustainability challenges. Social: Strengthens integrated care delivery. Economic: Avoids system fragmentation, duplication and improves efficiency.
 Leadership and advocacy	Advanced Development Framework / Professional & Personal	Driving practice transformation, influencing policy, and advocating for sustainability, health equity, and environmental stewardship. Leadership competencies are critical for pharmacists as game changers.	Environmental: Champions policies and practices for greener, sustainable pharmacy systems. Social: Promotes health equity and resilience. Economic: Encourages long-term system savings through sustainable models.

4 Knowledge & skills for sustainable pharmacy practice

Knowledge, skills and attitudes for sustainable pharmacy practice[4, 24-30]	
Core	
Mitigation*	Adaptation**
Knowledge • Recognise the environmental impacts across the full medicine lifecycle, from manufacturing and distribution through patient use and disposal, including emissions, energy use, and pharmaceutical waste. • Apply eco-friendly procurement methods, regulatory standards, and international guidelines that promote pollution prevention, resource efficiency, and sustainable supply chains. • Recognise how technology choices impact the environment and implement sustainable digital practices, such as minimising unnecessary data usage and choosing energy-efficient tools. • Understand how different medication formulations (such as dry powder inhalers versus metered-dose inhalers, and cold-chain liquid versus tablets) or routes of administrations (IV vs oral) affect environmental outcomes throughout the medicine lifecycle.	Knowledge • Understand how climate change directly impacts medicine effectiveness, availability, and patient behaviour. • Understand how disease patterns and prevalence evolve over time and help to guide effective climate adaptation measures, enabling health systems to anticipate and respond to climate-related health risks. • Recognise how certain groups face greater risks from climate-related medication disruptions and environmental health threats. • Identify weak points in pharmaceutical supply chains and healthcare delivery systems that are vulnerable to environmental disruptions. • Interpret air quality data and incorporate it into patient counselling and education. • Engage with public health by understanding socioeconomic factors that influence health at both population and individual levels. • Remain informed on public health campaigns, risk communication strategies, and local environmental health initiatives such as pharmacy-based vaccination programmes. • Recognise the contribution of non-adherence to prescribed regimens to medicines waste.
Skills • Discuss environmental responsibility with patients, colleagues, students and stakeholders, including guidance on sustainable medication choices and proper disposal practices. • Implement smart supply chain strategies using automation and demand forecasting strategies to prevent overstocking and reduce waste. • Manage pharmacy operations to maximise energy efficiency through different initiatives such as LED lighting, proper insulation, smart climate control, and efficient equipment usage.	Skills • Adapt medicine sourcing, distribution, and storage practices during environmental emergencies such as extreme weather events or natural disasters. • Provide targeted guidance to help patients minimise air pollution exposure through strategies such as optimised inhaler use, protective masks, and proper ventilation. • Inform patients about heat-related risks (such as dehydration, heat exhaustion, and physical exertion), and practical preventive measures.

• Develop and support pharmaceutical waste return or redistribution as appropriate, and take-back programmes in both community and hospital settings. • Use environmental health tools such as point-of-care testing or spirometry to identify patient risk factors and make appropriate referrals.	• Use validated screening tools to identify patients affected by air pollution-related illnesses and make appropriate, timely referrals. • Apply knowledge of climate impacts on health to pharmacist roles in clinical care. • Proactively anticipate climate-related health crises while engaging in public health research on the impact of climate change on communicable and non-communicable diseases to enhance system resilience. • Promote public health and mitigate harm from climate-driven hazards with other sector professionals.
Attitudes • Take a proactive, preventive approach to environmental responsibility across all pharmacy activities. • Commit to sustainability as a key dimension of healthcare quality, ensuring care is effective, responsible, and mindful of future generations by reducing environmental impact and promoting long-term well-being. • Commit to continuing education and collaboration to advance green pharmacy practices. • Build shared responsibility with patients and communities about medication-related environmental impacts. • Advocate for transparency, ethical sourcing, and alignment with Environmental, Social, and Governance (ESG) principles. • Support teamwork across healthcare disciplines to advance sustainable healthcare systems.	Attitudes • Guide patient behaviour modifications that support medication adherence, reduce health risks, and promote sustainable treatment approaches. • Work with other healthcare disciplines and sectors to support climate adaptation strategies in pharmacy and health practices. • Convert environmental and air quality information into practical, personalised advice and risk reduction strategies for individual patients. • Maintain empathy and patient-centred care even when delivering services under environmental pressures or resource constraints. • Position pharmacy as a local hub for environmental health education and climate resilience. • Advocate for fair and equitable healthcare access while prioritising the needs of vulnerable and high-risk populations affected by climate change. • Make transparent, context-sensitive choices when facing competing demands using problem solving skills, especially regarding resource allocation.
Note: For this publication, we recognise that some of the knowledge and skill areas may be specific to certain fields of practice, while others apply across multiple settings. The distinctions outlined are indicative rather than exhaustive and do not represent all areas or every context.	
Advanced/Specialised	

Clinical practice	Industrial pharmacy	Academic pharmacy	Policy making
Knowledge • Coordinate delivery routes, joint shipments, and digital inventory systems (e.g., FIFO, expiry management). • Use guidelines on appropriate dispensing quantities, deprescribing principles, and polypharmacy reduction. • Understand the medicine lifecycle impact (e.g., inhalers). • Understand the importance of environmentally safe disposal practices. • Encourage patient participation in sustainability (e.g., use reusable bags, explain disposal options). • Explore ongoing provider–patient relationship benefits (adherence, outcomes, resource efficiency). • Understand the use of mobile health apps, smart pill dispensers, electronic monitors, telepharmacy, and data analytics for adherence support.	Knowledge • Apply concepts of lifecycle emissions awareness. • Understand green chemistry and sustainable laboratory practices. • Understand waste reduction through digitalisation, eco-labelled materials, and reduced printing. • Be aware of water-saving strategies (e.g., efficient fixtures, rainwater harvesting). • Be aware of durable, repairable, and locally sourced furniture/equipment. • Be familiar with frameworks such as the Laboratory Efficiency Assessment Framework (LEAF). • Recycle and reuse systems for packaging. • Be aware of extended producer responsibility (EPR) policies and circular economy principles.	Knowledge • Understand how to integrate Environmental Sustainability in Pharmacy Practice (ESPP)[24] into curricula and accreditation standards. • Raise awareness of essential principles, values, and skills needed for sustainable and responsible pharmacy practice. • Understand the concept and importance of patient activation (empowering patients by knowledge, skills, confidence). • Evidence linking activation to better adherence, preventive behaviours, and health outcomes. • Understand behavioural change frameworks and how they guide patient engagement and adherence strategies.	Knowledge • Understand the integration of environmental risk assessments into medicine approval and registration processes. • Understand the relevance of the Basel and Stockholm Conventions to pharmaceutical waste management. • Be aware of extended producer responsibility (EPR) policies and circular economy principles. • Understand issues with inadequate pharmaceutical donations. • Follow best practice guidelines for responsible donation and safe redistribution of medicines. • Understand the importance of reducing emissions from healthcare-related travel and promote green transportation options. • Understand how to use formulary agreements, quantity control methods, and multi-dose dispensing to reduce waste.
Skills • Optimise stock rotation, adjusting therapy based on patient needs, and supporting deprescribing. • Educate patients on safe disposal, adherence, and sustainability practices. • Collaborate with prescribers and healthcare teams to ensure continuity of care. • Provide clear instructions and leaflets encouraging medicine returns whenever applicable.	Skills • Replace solvent-based tablet coatings with water-based or safer alternatives. • Implement waste minimisation and digital solutions to reduce paper/packaging. • Apply LEAF guidelines and green chemistry techniques. • Implement water-saving infrastructure and monitoring consumption.	Skills • Embed ESPP concepts into course design, learning outcomes, and assessment criteria. • Apply behavioural change models to tailor interventions. • Deliver accessible, person-centred education and motivation to patients. • Use empathy and consistent interaction to sustain patient engagement.	Skills • Draft and implement national waste management policies and manufacturer guidelines. • Promote green pharmacy practices and circular economy models. • Create programmes to gather and share environmental hazard data globally. • Set up transparent, regulated platforms for safe redistribution of near-expiry medicines.

• Set up and monitor digital reminders, apps, and smart dispensers. • Use dashboards and data analytics to detect non-adherence and intervene proactively. • Explore feasibility and safety of redispensing medicines whenever applicable. • Streamline logistics to minimise waste and cost.	• Design and manage recycling programmes for packaging and material reuse. • Use innovating systems to optimise medicine use and reduce pharmaceutical waste.		• Coordinate agreements between pharmacists and prescribers to tailor dispensing to patient needs. • Engage with stakeholders in aligning with international conventions and sustainability goals.
Attitudes • Commit to personalised care, regular follow-ups, and tailoring therapy based on clinical and non-clinical needs. • Take a proactive role in reducing medication waste and packaging. • Support reuse, safe disposal, and sustainable practices in daily pharmacy operations. • Be willing to adopt digital tools, telepharmacy, and new adherence technologies to improve outcomes and efficiency. • Value interprofessional coordination and shared responsibility for patient outcomes and environmental health.	Attitudes • Commit to reducing emissions, waste, and chemical hazards in production. • Prioritise eco-friendly materials and solutions over traditional, higher-impact ones. • Be open to adopt new technologies and processes that promote sustainability. • Commit to responsible manufacturing and protecting public and environmental health. • Adhere to extended producer responsibility (EPR) policies.	Attitudes • Advocate for the integration of sustainability and public health into pharmacy education. • Believe in empowering patients as active partners in their care. • Dedicate to motivating and enabling patients rather than only informing them.	Attitudes • Commit to mitigate medicine-related environmental hazards. • Promote sustainable transportation and logistics for reducing emissions. • Ensure donations are safe, appropriate, and minimise waste. • Embrace a circular, resource-efficient healthcare model that preserves resources and improves access while reducing environmental impact.

Cross-cutting knowledge and skills spanning diverse pharmacy sectors

Knowledge

- Be aware of the environmental footprint of digitisation (data storage, processing) including the understanding of practical mitigation strategies such as deleting unused data, reducing duplication, using eco-friendly search engines, lowering video resolution, using virtual meetings.
- Understand forecasting techniques that reduce overstock and waste.
- Understand procurement decisions based on environmental impacts.
- Classify waste as non-hazardous, hazardous, or controlled substances, including subcategories such as antineoplastics and anti-infectives..
- Understand and differentiate between optimal and interim disposal treatment options.
- Understand the need to avoid uncontrolled landfill disposal and low-temperature incineration without flue gas treatment.
- Be familiar with the three-bin system (infectious waste, sharps, general waste).

- Use reusable sharp/cytotoxic bins to reduce single-use plastics.

Skills

- Implement data hygiene practices such as deleting, compressing and consolidating.
- Conduct sustainable procurement planning and inventory forecasting.
- Apply waste classification and segregation protocols accurately.
- Implement adequate storage and eco-friendly transport methods.
- Select appropriate treatment based on waste characteristics, technology availability, cost, and environmental impact.

Attitudes

- Commit to minimising digital and physical waste footprints.
- Dedication to using safe, eco-friendly disposal treatment and methods.
- Avoid unsafe disposal practices even when they appear cheaper or faster.
- Seek innovative, sustainable alternatives for waste segregation, transport, and treatment.
- Advocate for systemic solutions like circular practices.

* Mitigation measures in pharmacy involve reducing pharmaceutical pollution and climate impact by minimising medicine waste, ensuring proper disposal, lowering emissions from medicine production and use, and strengthening the pharmacist's role in preventive care, particularly in high-emission countries.
** Adaptation in pharmacy refers to measures that support the health of individuals and communities affected by climate change and ecological crises. This includes ensuring equitable access to medicines, optimising treatment to minimise environmental impact, and equipping pharmacists to respond to climate-related health challenges such as extreme heat, natural disasters, and the management of chronic diseases under changing conditions, all while maintaining pharmacy services in vulnerable and resource-limited settings.

5 Advancing sustainability through education, training and workforce development

Curriculum design

Understanding pharmacy students' experiences and learning needs regarding climate change is fundamental to developing effective educational programmes. While awareness of climate change's health impacts among healthcare professionals is slowly growing, many healthcare professionals still have limited understanding, which highlights the need for more targeted education and training.

To address this gap, sustainability-related knowledge and skills should be systematically integrated into pharmacy curricula, through new dedicated courses or the adaptation of existing ones. Strategies for integration include embedding content on climate change, environmental sustainability, and planetary health across core teaching and assessment.[28-30]

While education and training programmes are essential for minimising infection transmission and fostering environmental responsibility among pharmacy staff, public awareness campaigns play an equally important role in educating the wider community about healthcare waste risks and proper disposal practices.

Regulatory framework and professional responsibilities

Pharmacy regulators bear significant responsibility in embedding environmental sustainability into professional standards. This includes introducing mandatory environmental risk assessments for pharmaceutical products, ensuring documentation reflects current environmental standards, and strengthening data collection on greenhouse gas emissions and waste.

Pharmacy regulators also influence education by embedding sustainability within accreditation requirements for pharmacy programmes and establishing mechanisms to recognise pharmacies' environmental performance.

Adaptation strategies should include mandatory training on disaster preparedness and strengthening infrastructure to withstand climate-related hazards. Emergency response protocols must balance immediate needs with long-term planning: for example, while temporary measures such as encapsulation in uncontrolled landfills may be unavoidable during crises, these must be coupled with strategies to establish safer, more sustainable disposal practices.

FIP Seal for programmes and CPD providers

The FIP Provision Programme provides a global platform to support FIP members and the wider profession in advancing professional development and strengthening the pharmaceutical workforce in line with local and national needs. By facilitating collaboration across members and partners, the programme enables the sharing of good practices, the identification of opportunities, and the acceleration of workforce transformation across all pharmacy sectors.

The FIP Seal is awarded to programmes that meet established quality criteria and demonstrate alignment with FIP's mission, goals, and Development Goals. It serves as a mark of international recognition, helping providers strengthen the credibility, visibility, and impact of their programmes.

By encouraging the development and sharing of high-quality professional programmes, the FIP Seal also supports efforts to address knowledge and skills gaps in pharmacy. This Knowledge & Skills reference guide can serve as a foundation for designing and updating such programmes, ensuring that training opportunities are relevant, evidence-based, and aligned with global sustainability priorities. In this way, the guide and the Seal together foster the advancement of workforce competencies while accelerating the integration of sustainability principles into pharmacy education and practice.

Conclusions

While education and workforce development are critical for equipping pharmacists with the competencies needed for sustainability, these must be supported by enabling policies and system-level measures to ensure their application in practice. FIP has already articulated these enablers in its Statement of Policy on Environmental sustainability within pharmacy (2023), which calls for regulatory incentives, investment in sustainable models of care, and system-wide monitoring and accountability. Readers are encouraged to consult this statement for detailed recommendations on policy actions to complement the knowledge and skills outlined in this guide.

6 References

1. Ladhar S, Gill J, Frank I et al. Student perspectives on the integration of environmental sustainability and climate Change into the doctor of pharmacy program curriculum. Curr Pharm Teach Learn. 2025;17(6):102347. [Acessed: 29 October 2025]. Available at: https://www.ncbi.nlm.nih.gov/pubmed/40186927.

2. Romanello M, Walawender M, Hsu SC et al. The 2024 report of the Lancet Countdown on health and climate change: facing record-breaking threats from delayed action. Lancet. 2024;404(10465):1847-96. [Acessed: 29 October 2025]. Available at: https://www.ncbi.nlm.nih.gov/pubmed/39488222.

3. Barratt AL, Bell KJ, Charlesworth K et al. High value health care is low carbon health care. Med J Aust. 2022;216(2):67-8. [Acessed: 29 October 2025]. Available at: https://www.ncbi.nlm.nih.gov/pubmed/34699070.

4. Hibbard JH, Stockard J, Mahoney ER et al. Development of the Patient Activation Measure (PAM): conceptualizing and measuring activation in patients and consumers. Health Serv Res. 2004;39(4 Pt 1):1005-26. [Acessed: 29 October 2025]. Available at: https://www.ncbi.nlm.nih.gov/pubmed/15230939.

5. Bazemore A, Merenstein Z, Handler L et al. The Impact of Interpersonal Continuity of Primary Care on Health Care Costs and Use: A Critical Review. Ann Fam Med. 2023;21(3):274-9. [Acessed: 29 October 2025]. Available at: https://pubmed.ncbi.nlm.nih.gov/37217332/.

6. aus der Beek T, Weber FA, Bergmann A et al. Pharmaceuticals in the environment--Global occurrences and perspectives. Environ Toxicol Chem. 2016;35(4):823-35. [Acessed: 29 October 2025]. Available at: https://pubmed.ncbi.nlm.nih.gov/26666847/.

7. Watts N, Amann M, Arnell N et al. The 2019 report of The Lancet Countdown on health and climate change: ensuring that the health of a child born today is not defined by a changing climate. Lancet. 2019;394(10211):1836-78. [Acessed: 29 October 2025]. Available at: https://www.ncbi.nlm.nih.gov/pubmed/31733928.

8. Secretariat of the Basel Convention. Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal: UNEP; 1992.

9. International Energy Agency. CO_2 Emissions from Fuel Combustion. Paris: OECD/IEA; 2022.

10. Healthcare Without Harm Europe. Circular Healthcare: Strategies for Sustainable Health Systems. 2019. [Acessed: 29 October 2025]. Available at: https://europe.noharm.org/circular-healthcare.

11. United Nations Office on Drugs Crime. Guidelines for the Safe Disposal of Unwanted Pharmaceuticals in and after Emergencies: UNODC; 2011.

12. Kümmerer K. Pharmaceuticals in the Environment: Sources, Fate, Effects and Risks: Springer; 2009.

13. International Pharmaceutical Federation. Green Pharmacy Policy Statement. The Hague: [Internet]. 2016. [Acessed: 29 October 2025]. Available at: https://www.fip.org/file/1535.

14. OECD. Extended Producer Responsibility: Updated Guidance for Efficient Waste Management. Paris: [Internet]. 2016. [Acessed: 29 October 2025]. Available at: https://www.oecd.org/content/dam/oecd/en/publications/reports/2016/09/extended-producer-responsibility_g1g6742c/9789264256385-en.pdf.

15. Intergovernmental Panel on Climate Change. Climate Change 2014: Synthesis Report. [Internet]. 2014. [Acessed: 29 October 2025]. Available at: https://www.ipcc.ch/report/ar5/syr/.

16. Guinée JB. Handbook on Life Cycle Assessment: Operational Guide to the ISO Standards: Springer; 2002.

17. Health Care Without Harm. Pharmaceuticals and the Environment: Reducing Emissions and Waste. [Internet]. 2021. [Acessed: 29 October 2025]. Available at: https://noharm.org/pharmaceuticals.

18. Intergovernmental Panel on Climate Change. Global Warming of 1.5°C: Special Report. [Internet]. 2018. [Acessed: 29 October 2025]. Available at: https://www.ipcc.ch/sr15/.

19. Maack G. In response: governmental perspective. Environ Toxicol Chem. 2014;33(9):1918-20. [Acessed: 29 October 2025]. Available at: https://www.ncbi.nlm.nih.gov/pubmed/25138029.

20. Whitmee S, Haines A, Beyrer C et al. Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation-Lancet Commission on planetary health. Lancet. 2015;386(10007):1973-2028. [Acessed: 29 October 2025]. Available at: https://www.ncbi.nlm.nih.gov/pubmed/26188744.

21. Wang J, Guo X. Green solvents for sustainable organic synthesis. Current Opinion in Green and Sustainable Chemistry. 2015;2:25-9. [Acessed: 29 October 2025]. Available at: https://www.researchgate.net/publication/361663815_Green_Solvents_for_Sustainable_Organic_Synthesis_An_Overview.

22. Stockholm Convention Secretariat. Stockholm Convention on Persistent Organic Pollutants (POPs). [Internet]. 2001. [Acessed: 29 October 2025]. Available at: https://www.pops.int/.

23. World Health Organization. Safe Management of Wastes from Health-care Activities (2nd ed.). Geneva: [Internet]. 2014. [Acessed: 29 October 2025]. Available at: https://www.who.int/publications/i/item/9789241548564.

24. Chen EYH, Forrester C, McEvoy AM et al. Pharmacy students' perceptions on environmental sustainability in pharmacy education and practice. Explor Res Clin Soc Pharm. 2023;12:100366. [Acessed: 29 October 2025]. Available at: https://www.ncbi.nlm.nih.gov/pubmed/38045651.

25. International Pharmaceutical Federation (FIP). FIP statement of policy: Environmental sustainablity within pharmacy. The Hague: [Internet]. 2023. [Acessed: 29 October 2025]. Available at: https://www.fip.org/file/5618.

26. Royal Dutch Pharmacists Association. Green pharmacy toolkit. [Internet]. 2024. [Acessed: 29 October 2025]. Available at: https://sustainability.fip.org/wp-content/uploads/2024/09/Green-Pharmacy-Groene-Apotheek-Engelstalig-def.pdf.

27. Group SiPES. Environmental sustainability in pharmacy education. [Internet]. 2023. [Acessed: 29 October 2025]. Available at: https://drive.google.com/file/d/1VsGb6vnaFOFLgCO41Yr4miMPRoQxhWhF/view.

28. Mathers A, Fan S, Austin Z. Climate change at a crossroads: Embedding environmental sustainability into the core of pharmacy education. Can Pharm J (Ott). 2023;156(2):55-9. [Acessed: 29 October 2025]. Available at: https://www.ncbi.nlm.nih.gov/pubmed/36969305.

29. Carrion C, Llamas CA, Safitri ED et al. Conceptual frameworks, competencies, contents and teaching methods in planetary health education for health students and professionals: a global systematic scoping review. BMC Med Educ. 2025;25(1):956. [Acessed: 29 October 2025]. Available at: https://www.ncbi.nlm.nih.gov/pubmed/40598085.

30. Males J, Sorensen C, Campbell H et al. Core competencies to prepare health professionals to respond to the climate crisis. PLOS Climate. 2023;2(6):e0000230. [Acessed: 29 October 2025]. Available at: https://doi.org/10.1371/journal.pclm.0000230.

International
Pharmaceutical
Federation

Fédération
Internationale
Pharmaceutique

Andries Bickerweg 5
2517 JP The Hague
The Netherlands
-
T +31 (0)70 302 19 70
F +31 (0)70 302 19 99
fip@fip.org
-
www.fip.org