Breathing New Life into the Formulary

Managing Inhaled Therapies Across a Health System

Presented by:

Jeff Endicott, PharmD, BCCCP | Clinical Pharmacy Manager | UVM Medical Center

University of Vermont Health

Objectives

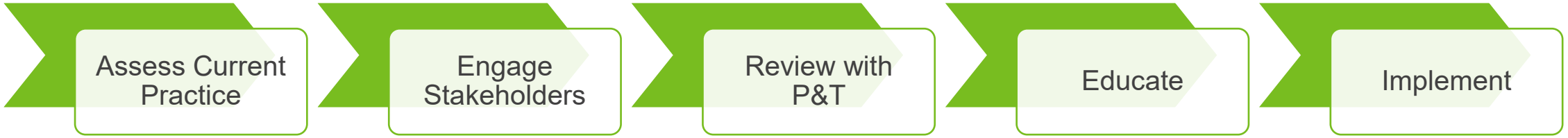
1) Identify key drivers impacting inhaled therapy formulary management

2) Describe the role and function of the Pharmacy and Therapeutics Committee

3) Summarize the change management strategy and impact of formulary changes across a system

Roadmap

Story of UVM Health's path to inhaler management



University of Vermont Health

UVM Health

At a Glance

1M+
SERVICE AREA POPULATION

15K+
EMPLOYEES

3.6B
TOTAL ANNUAL REVENUE

1,000+
LICENSED INPATIENT BEDS

ACADEMIC
MEDICAL CENTER

TWO
COMMUNITY HOSPITALS

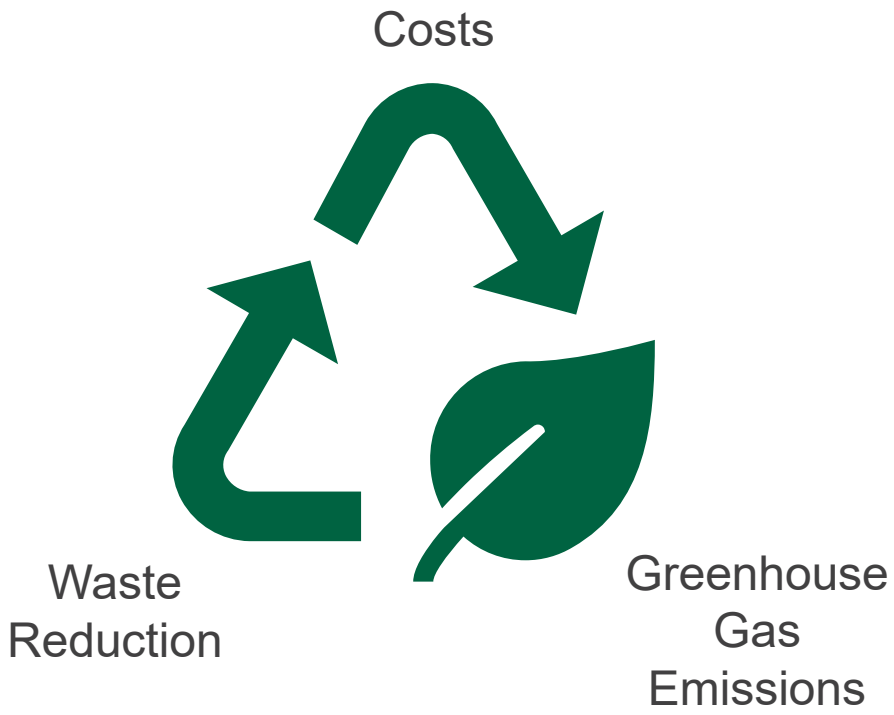
THREE
CRITICAL ACCESS HOSPITALS

HOME HEALTH & HOSPICE AGENCY

Beginnings

- Meeting between Respiratory and Pharmacy discussing waste
  - Inhaler waste
  - Discharging with utilized inhalers

- Limitations
  - Safety and patient education
  - Appropriate dispensing and labeling regulations by Board of Pharmacy



Waste and Cost

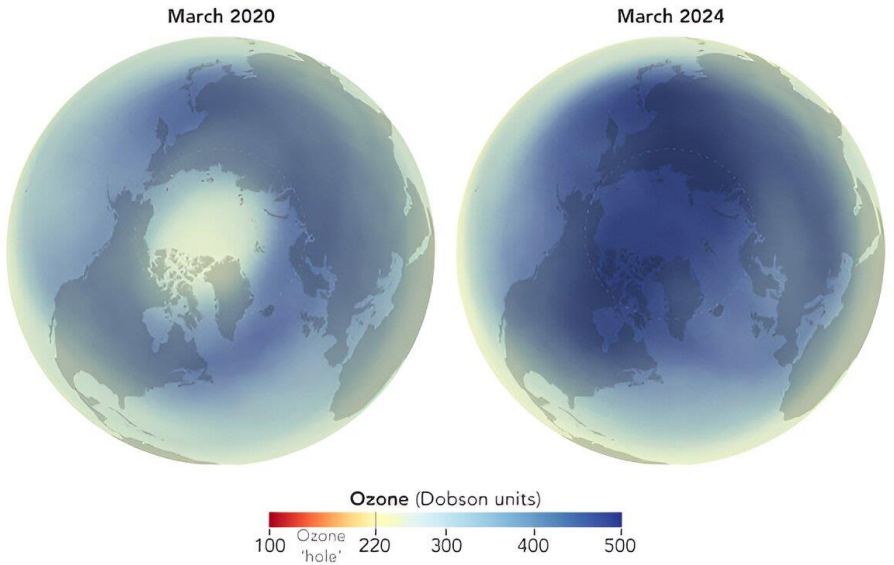
- Many inhaler devices produced in sizes to accommodate 1-month supply
  - Single center study estimated that 87% of doses for maintenance and short-acting agents were wasted

- Significant cost variability among inhalers
  - Branded products under patent
  - Proprietary delivery mechanisms
  - Supply chain and shortage events

Hosp Pharm. 2015;50(5):386-390.

Inhaler Environmental Impact

- 1987 Montreal Protocol
  - International treaty to protect the ozone layer of the stratosphere
  - Planned timeline to phase out ozone-depleting substances
  - Chlorofluorocarbons (CFC's) in Metered-Dose Inhalers (MDI's)
    - Throughout the 1990's and early 2000's phased out for dry-powder inhalers (DPI's) or MDI's utilizing hydroflurorocarbons (HFC's) or hydrofluoroalkanes (HFA's)
  - Ozone "hole" expected to be back to pre-1980s level by 2066



Am J Health-Syst Pharm. 2025;82:e607-e614

Sustainability

- UVM Health System Sustainability Director, Diane Imrie

- Assessing for Joint Commission Sustainability Certification
  - Collect and monitor data on various greenhouse gas (GHG) emissions
    - **Pressurized metered-dose inhaler use**
    - Energy use (fuel combustion)
    - Purchased electricity
    - Anesthetic gas use
    - Fleet vehicle carbon-based fuel use
    - Waste disposal

HFA Propellants

- HFA's have considerable global warming potential
- In 2018, HFA usage from MDI's accounted for approximately 18 million metric tons of carbon dioxide equivalent emissions
  - 3.9 million gasoline-powered vehicles over 1 year
  - Energy consumed by 1.8 million homes over 1 year

Propellant	Carbon Dioxide Equivalent Index (CO_2 = 1)
HFA-134a	**1,430**
HFA-227ea	**3,220**
CFC-12	10,200

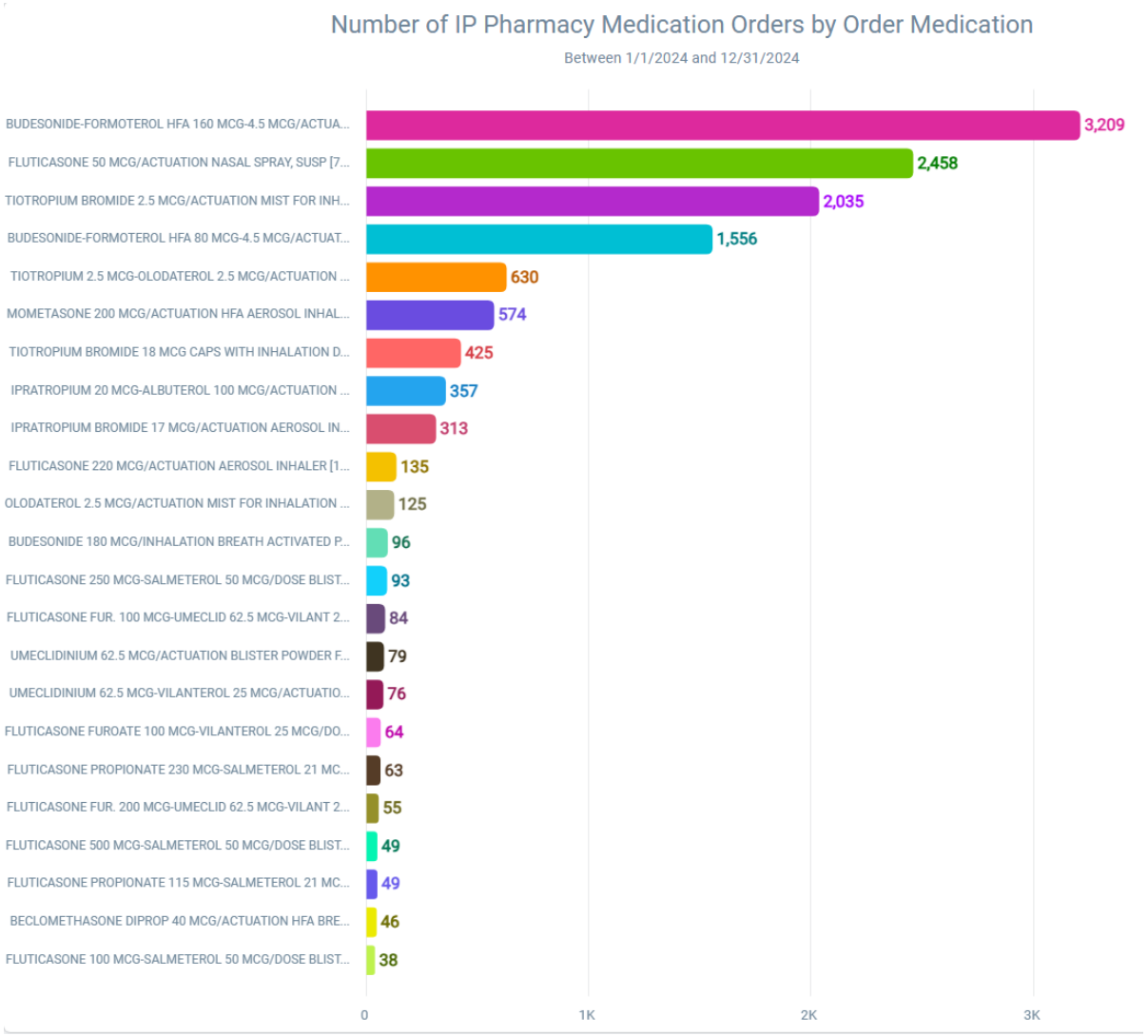
Am J Health-Syst Pharm. 2025;82:e607-e614
US Environmental Protection Agency. "Overview of Greenhouse Gases" https://www.epa.gov/ghgemissions/overview-greenhouse-gases

Defining the Problem

Inhaler Use Across UVM Health

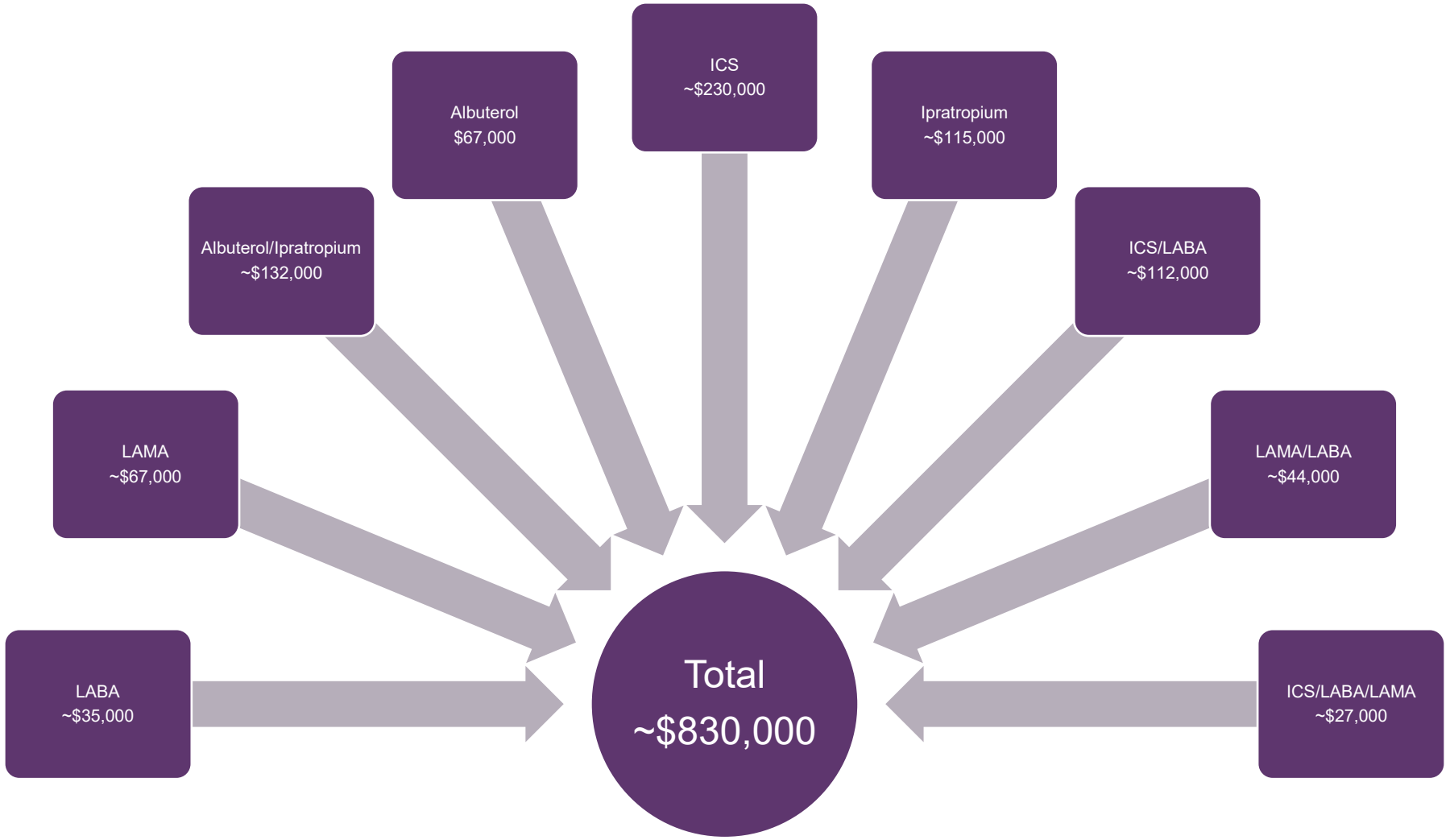
- Different products across formularies
- Some therapeutic interchanges/preferred agents
- Non-formulary use

Inhaler Use Across UVM Health



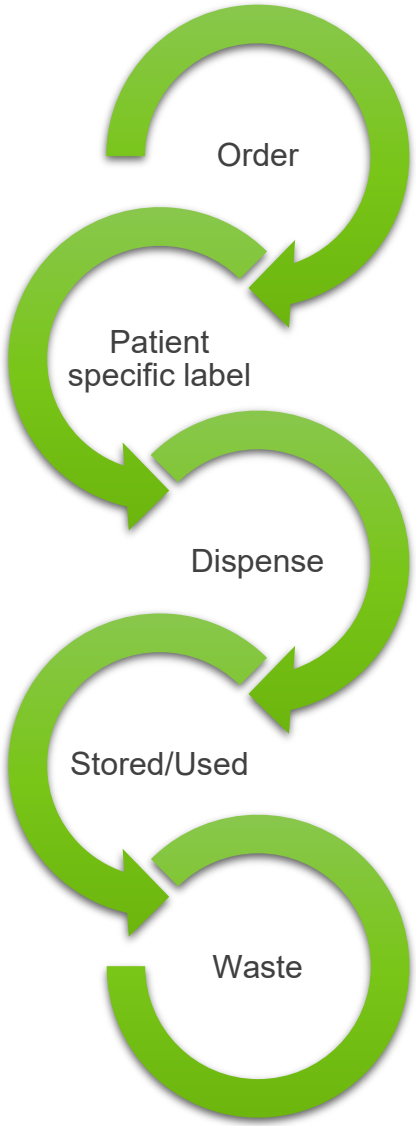
University of Vermont Health

Costs



University of Vermont Health

Waste



- Usage of albuterol and albuterol/ipratropium combination inhalers
  - Albuterol - Median [IQR] doses used from MDI: **2** [1-4]
  - Albuterol/Ipratropium – Median [IQR] doses used from device: **4** [1-8]
- Maintenance inhalers
  - Average LOS ~3-5 days
  - Inhalers with 1 month supply of drug are predominantly wasted
- Lost devices

System GHG Emissions

Product	Number of Inhalers Used Across System	Emissions (Metric Tons of CO_2 equivalent)
Budesonide/Formoterol 80/4.5 mcg	1759	43.69
Budesonide/Formoterol 160/4.5 mcg	3818	82.47
Mometasone/Formoterol 100/5 mcg	13	0.41
Mometasone/Formoterol 200/5 mcg	14	0.44
Ipratropium MDI 17 mcg	175	3.21
Albuterol MDI 90 mcg	8683	106.28
Fluticasone/Salmeterol 45/21 mcg	22	0.27
Fluticasone/Salmeterol 115/21 mcg	51	0.62
Beclomethasone 40 mcg	44	0.71
Fluticasone 44 mcg	129	2.09
Fluticasone 110 mcg	338	6.21
Fluticasone 220 mcg	137	2.52
Budesonide/Glycopyrolate/Formoterol 160/9/48 mcg	22	0.20
Glycopyrolate/Formoterol 9/4.8 mcg	6	0.10
	TOTAL	**249.23**

System GHG Emissions

58.1 gas-powered vehicles over 1 year

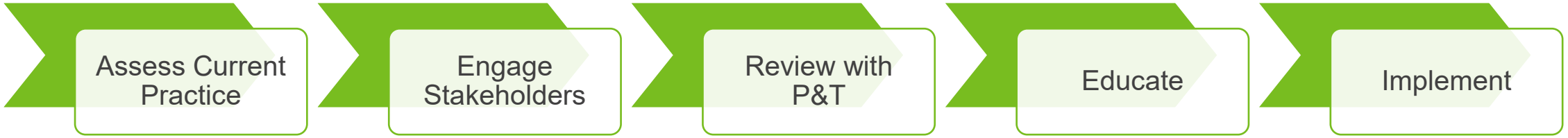
634,679 miles driven by gas-powered car

276,848 pounds of coal burned

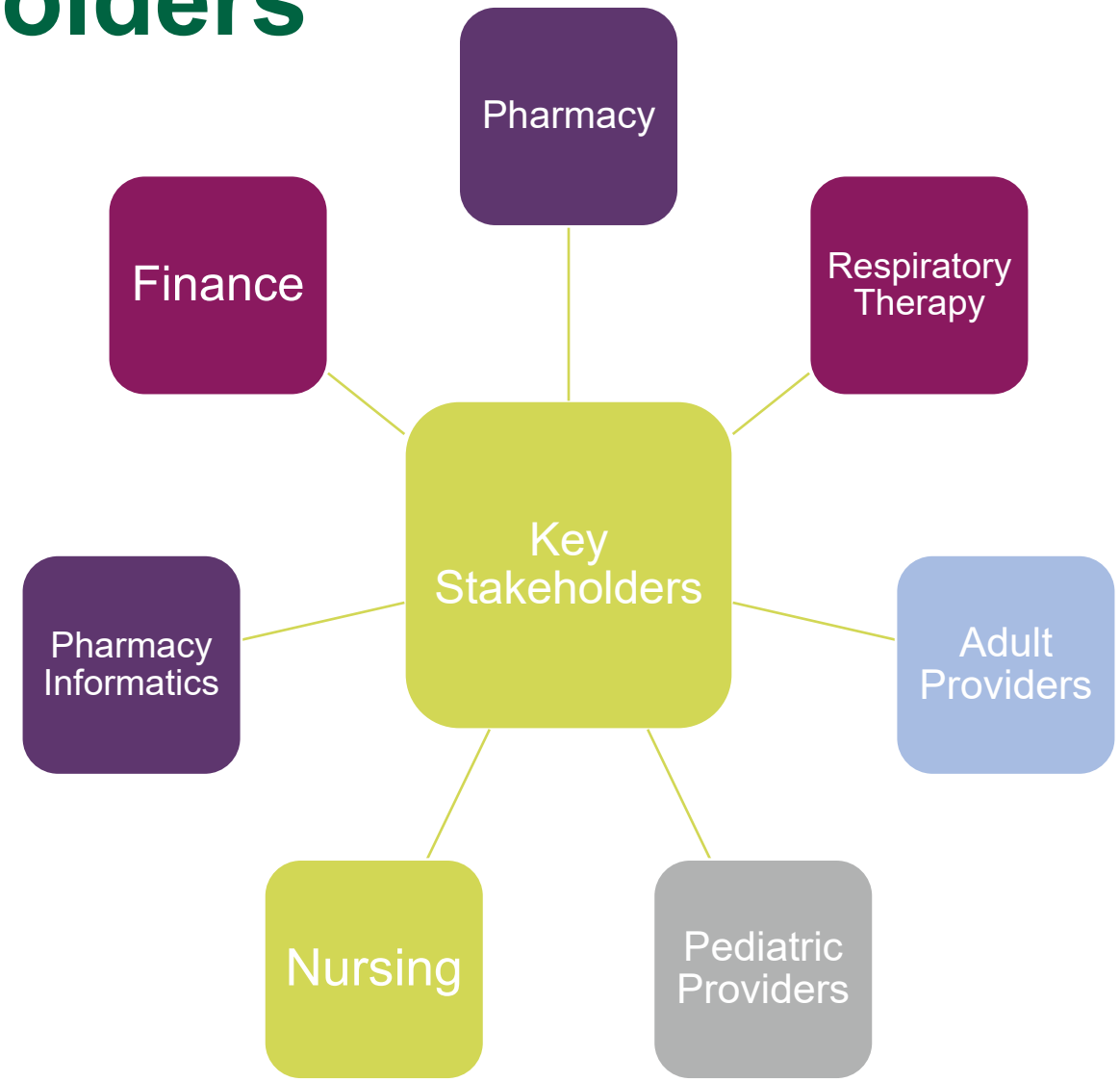
33.5 houses of energy use for 1 year

https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Back to the Roadmap

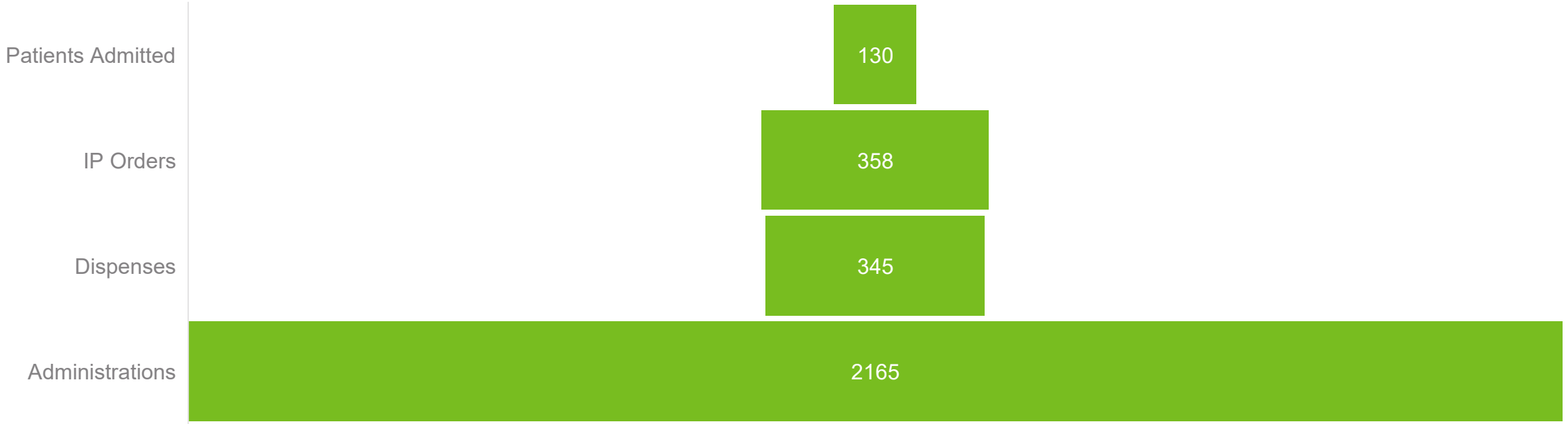


Key Stakeholders



Workflow Impact

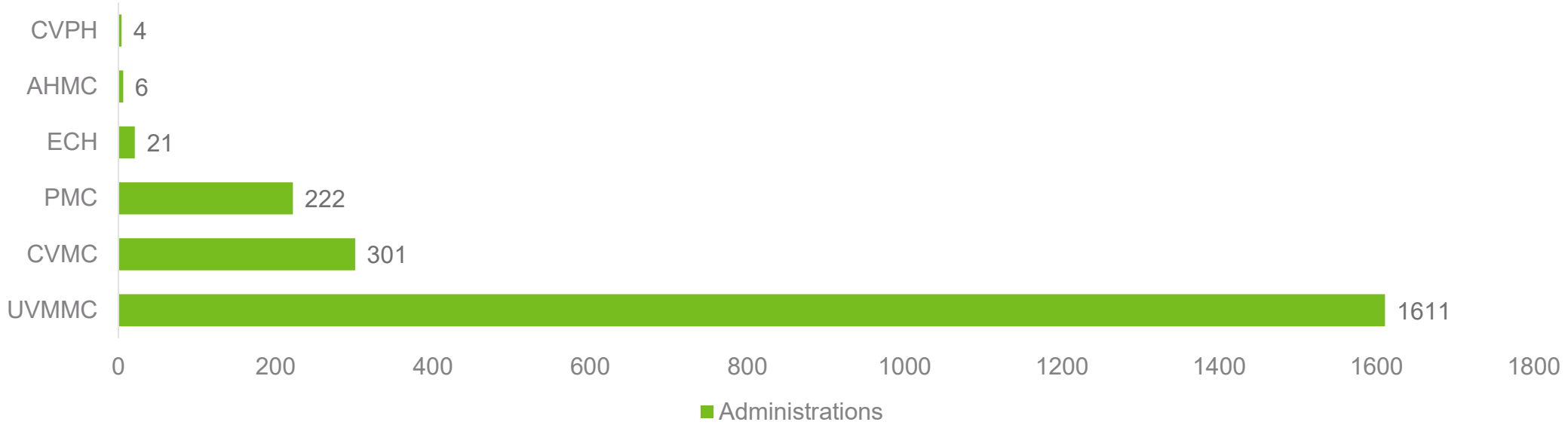
- Ipratropium/albuterol device utilization over 1 year



University of Vermont Health

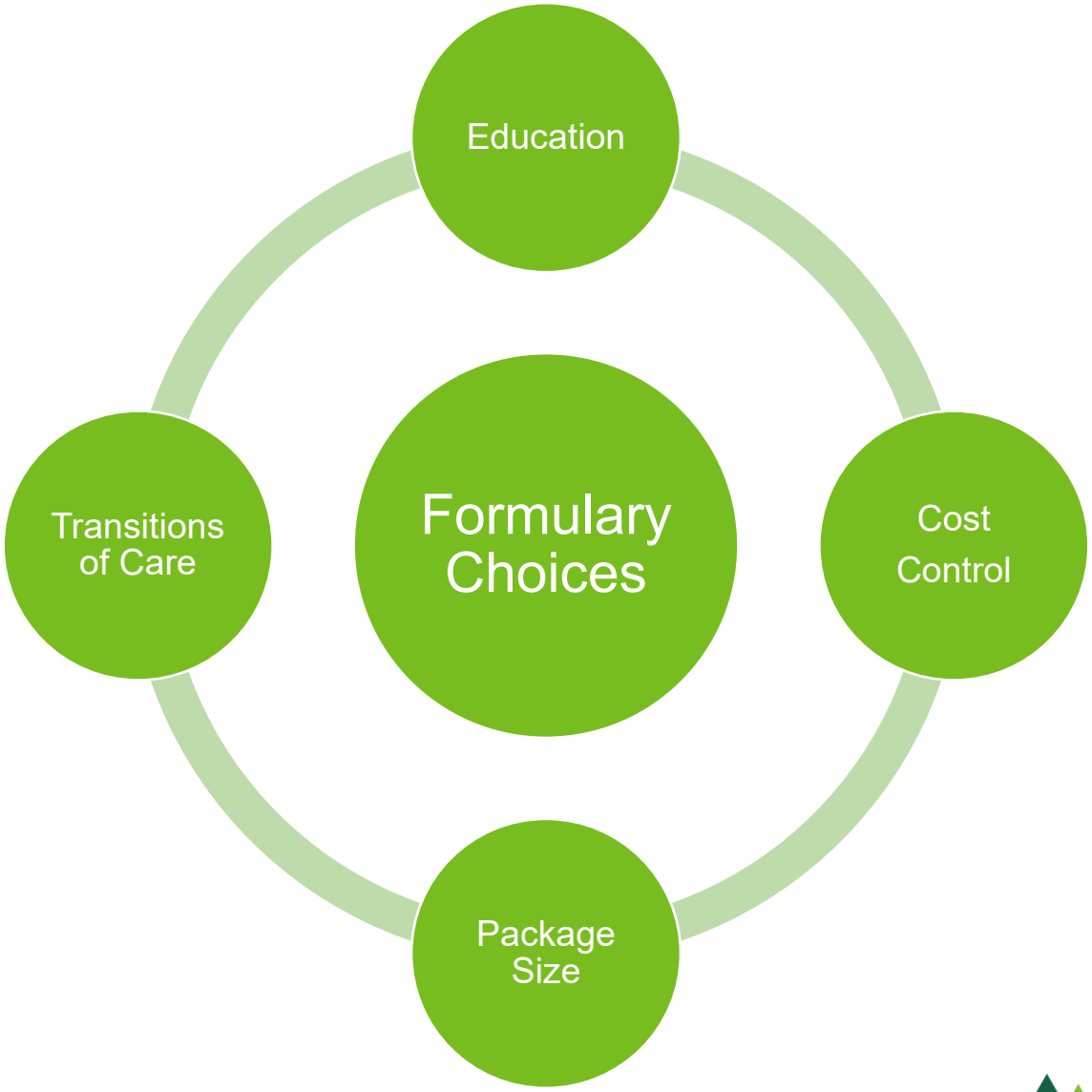
Workflow Impact

- Ipratropium/albuterol device use by hospital



University of Vermont Health

Inhaler Use Across UVM Health



University of Vermont Health

Planning

Leveraging Pharmacy and Therapeutics Committee

Pharmacy and Therapeutics Committee

- Interdisciplinary group
  - Pharmacists
  - Medical Staff
  - Nursing
  - Non-voting members
    - Clinical members (respiratory therapy, radiology, clinical nutrition)
    - Non-clinical members (compliance, risk management, quality improvement, finance)

- Goal
  - Overseeing policies and procedures related to all aspects of medication use across an organization
  - Managing the formulary system

- Guiding Principles
  - Safe
  - Rational
  - Evidence-based
  - Clinically appropriate
  - Cost-effective

Formulary

- Continually updated list of available medications and related information, representing the clinical judgement, resulting from a review of the clinical evidence, of physicians, pharmacists, and other clinicians in the diagnosis, prophylaxis, or treatment of disease and promotion of health.

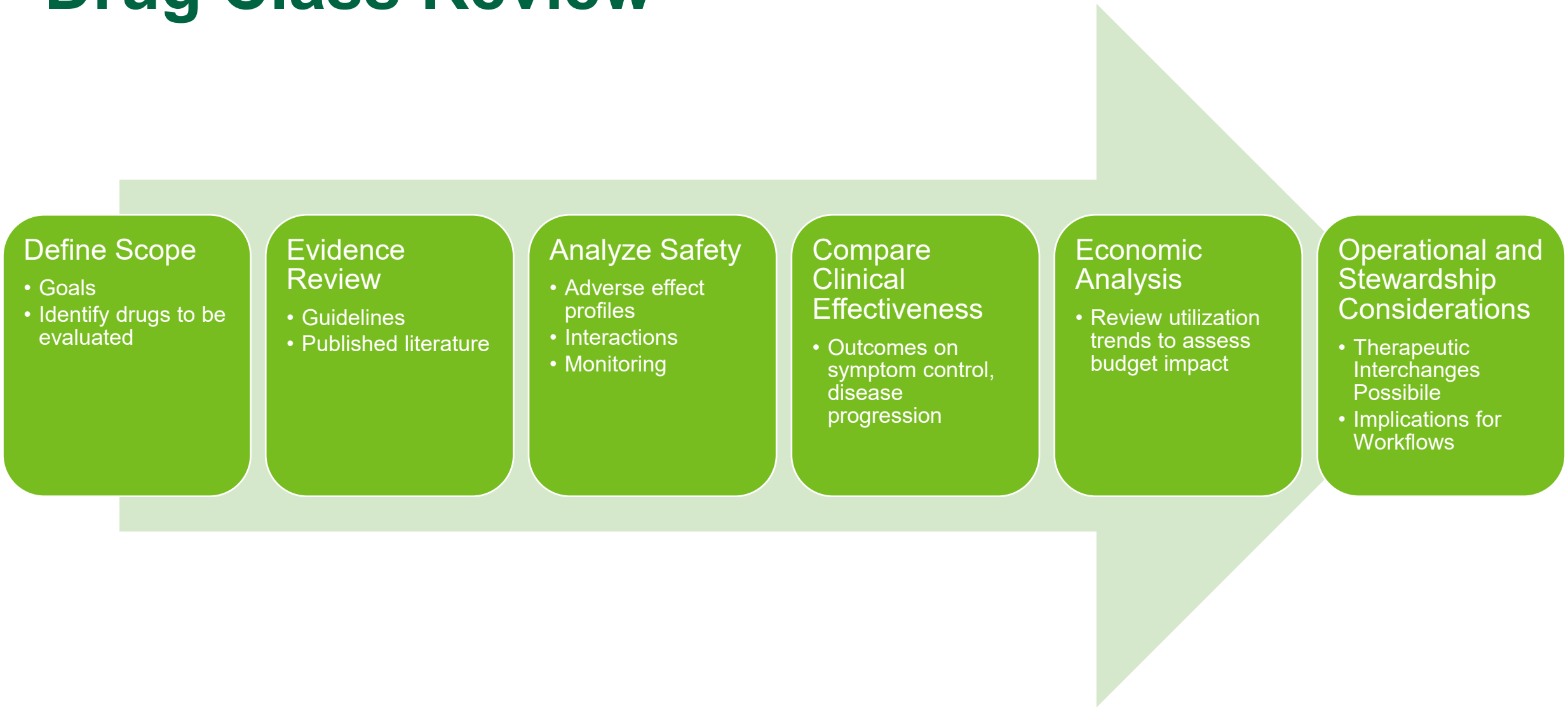
- Includes, but not limited to, a list of medications and medication-associated products or devices, medication-use policies, important drug information, decision-support tools, and organizational guidelines.

ASHP Guidelines on the Pharmacy and Therapeutics Committee and the Formulary System. *Am J Health-Syst Pharm* 2021.

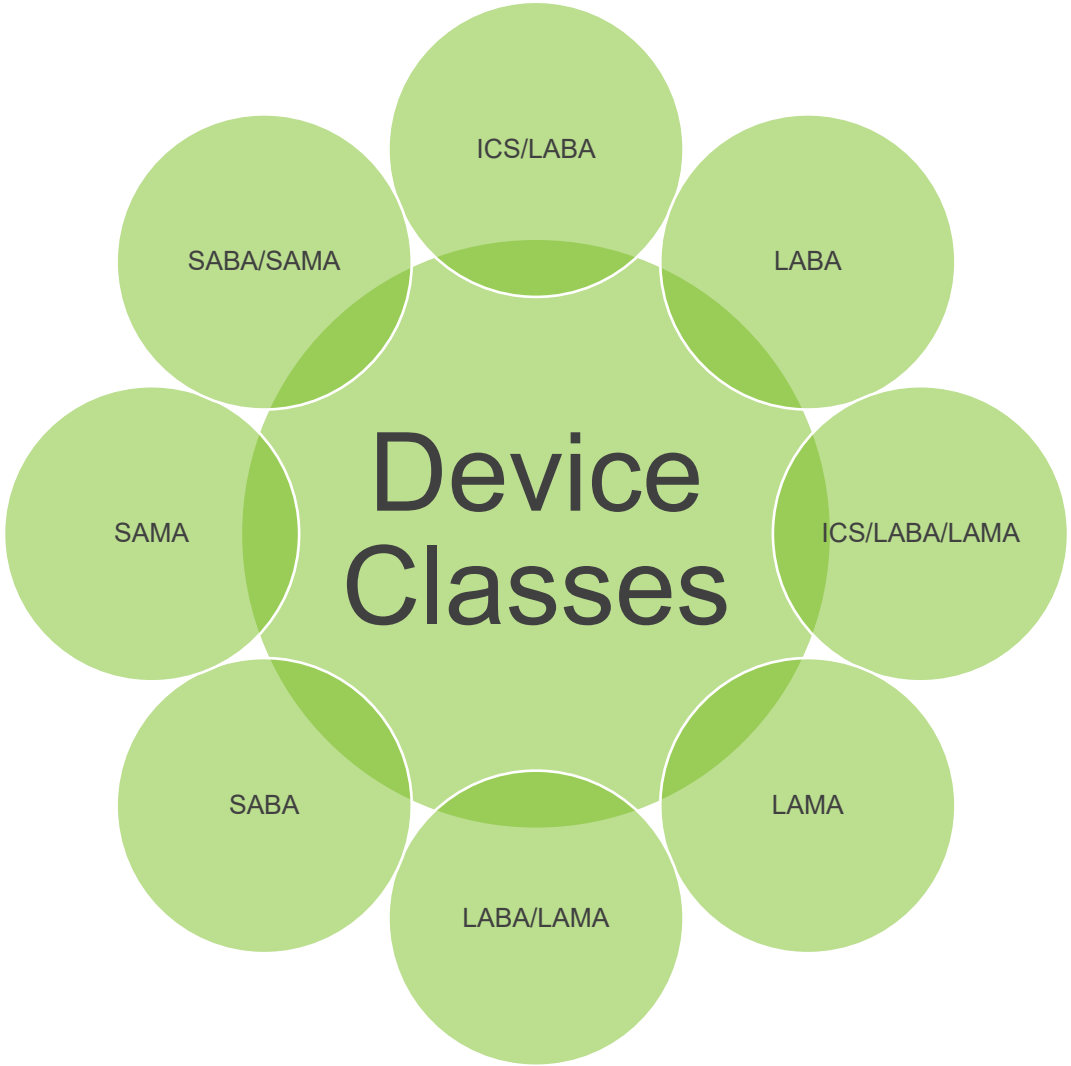
Managing a Formulary

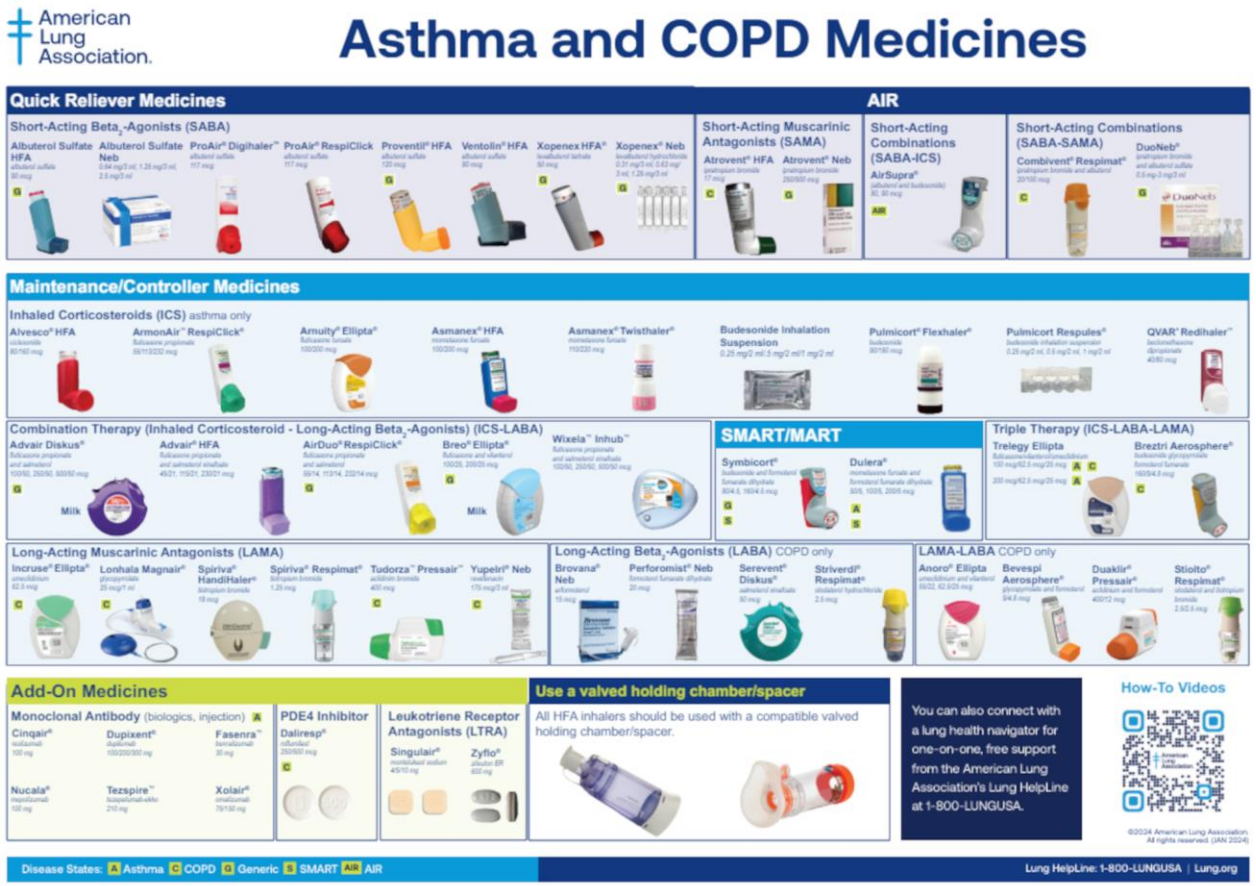
- Additions/removals/changes assessed by a pharmacist
  1. If the medication fulfills a therapeutic void in the existing formulary
  2. Comparative efficacy to both formulary and non-formulary medications
  3. Acquisition cost
  4. Dosage forms available
  5. Safety profile including propensity for medication errors, abuse potential, drug-drug interactions, drug-nutrient interactions, drug-disease interactions, REMS program requirements, and sentinel events
  6. Impact on clinical outcomes
  7. The medication is packaged and labeled safely
  8. High alert assessment needs, sound-alike or look-alike with another product currently on formulary
  9. Consideration of populations served including pediatric and geriatric patients
  10. Impact on laboratory, Radiology, infusion clinics, or other services as it pertains to receiving the medication requested
  11. Reimbursement
  12. Impact on administration setting and resources

Drug Class Review



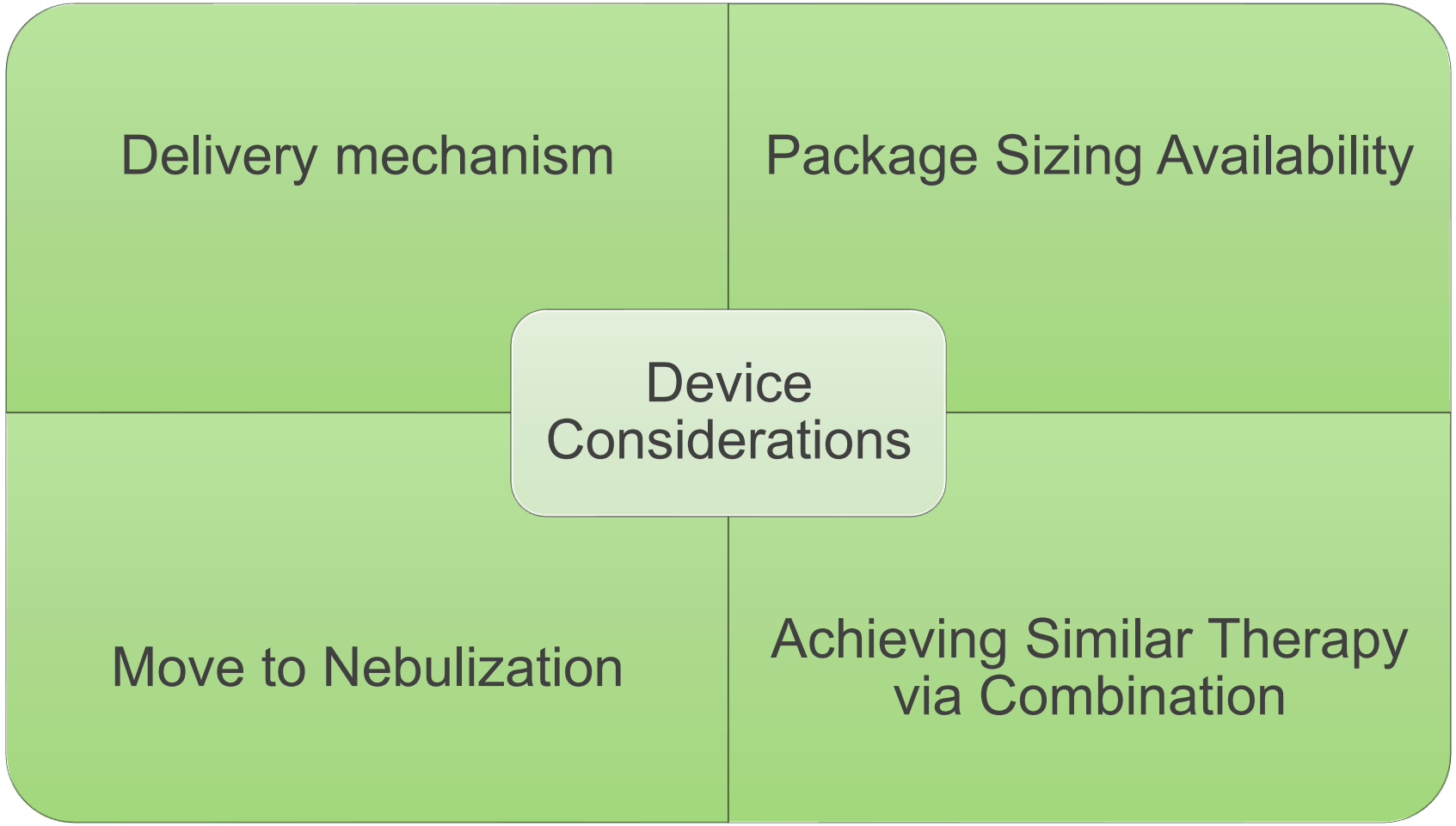
Grouping Drug Classes



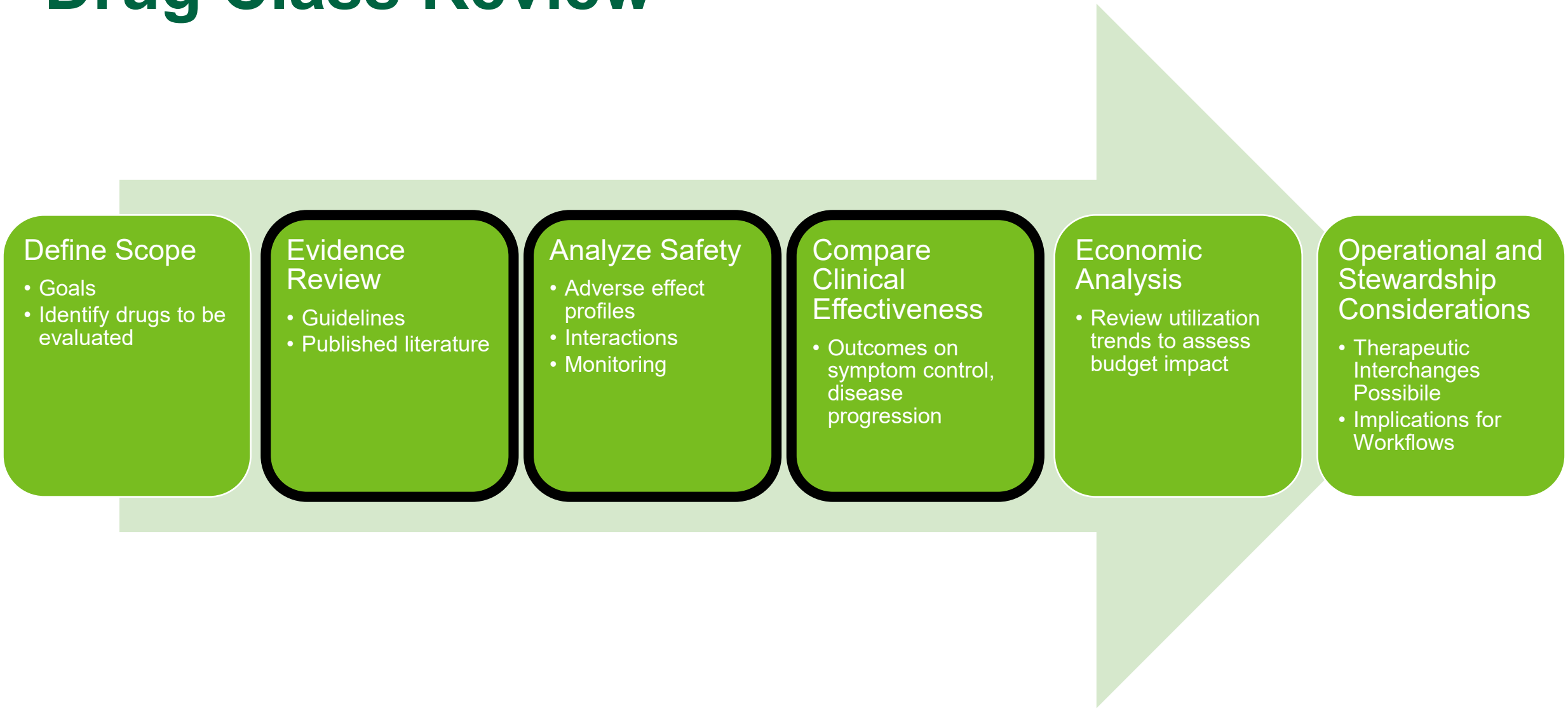


University of Vermont Health

Device Choices



Drug Class Review



Evidence Review

- Guidelines
  - GOLD COPD Guidelines
    - Recommend treatment based on exacerbation history and symptoms, as well as some specific patient scenarios like eosinophilia
    - Drug recommendations are class rather than drug specific
    - SABA, SAMA, LAMA, LAMA-LABA, ICS, LABA-LAMA-ICS
  - GINA Asthma Guidelines
    - Recommend treatment based on symptoms, patient ability, convenience
    - Recommendations for maintenance-and-reliever therapy (MART to ICS-Formoterol)
    - Recommendations for SABA, ICS-LABA, add-on LAMA

Global Initiative for Chronic Obstructive Lung Disease, 2026
Global Initiative for Asthma, 2025

Evidence Review

- Ohio State Wexner Medical Center, Columbus, OH
  - *Loborec SM, et al. Financial effect of converting ipratropium-albuterol therapy from inhalers to nebulizer treatments at an academic health system. Am J Health-Syst Pharm. 2016; 73:121*
- Non-academic, 326-bed medical center in Las Vegas, NV
  - *Gonzalez E, et al. Economic and workload impact of therapeutic interchange of inhaler medications and nebulizer solutions. Am J Health-Syst Pharm. 2020; 78:41*
- Banner Desert Medical Center, Mesa, AZ
  - *Larson T. Economic impact and chronic obstructive pulmonary disease outcomes of a comprehensive inhaler to nebulization therapy protocol implementation in a large multi-state healthcare system. Curr Med Res and Opin. 2019; 35:1805*

Interprofessional collaboration can lead to organizational cost savings

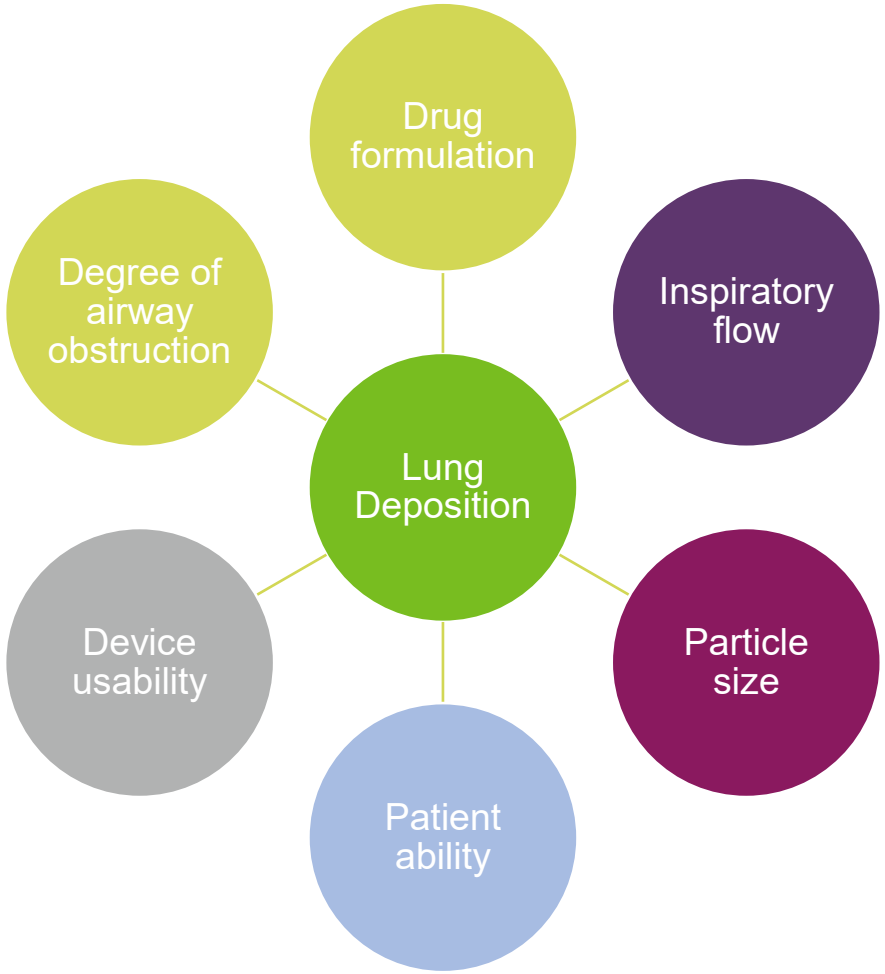
1 article noted increased Respiratory Therapist workload, while 1 noted a decrease

No impact on length of stay or readmissions

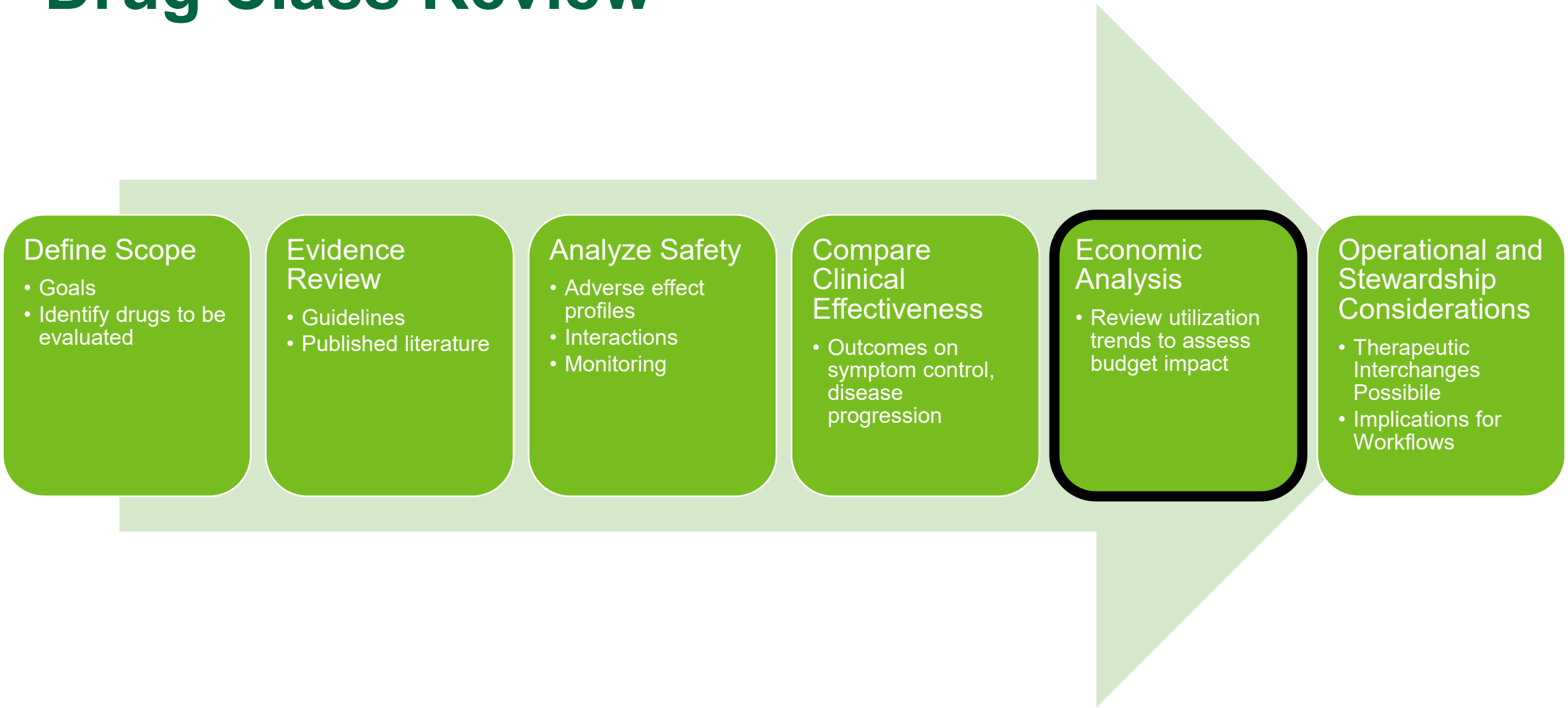
Notable cost savings across all three publications

Drug and Device Differences

- Device selection impacts drug deposition
  - All devices (when used appropriately) should be effective and achieve appropriate clinical response
  - No adverse outcomes seen in published literature when switching temporarily while admitted

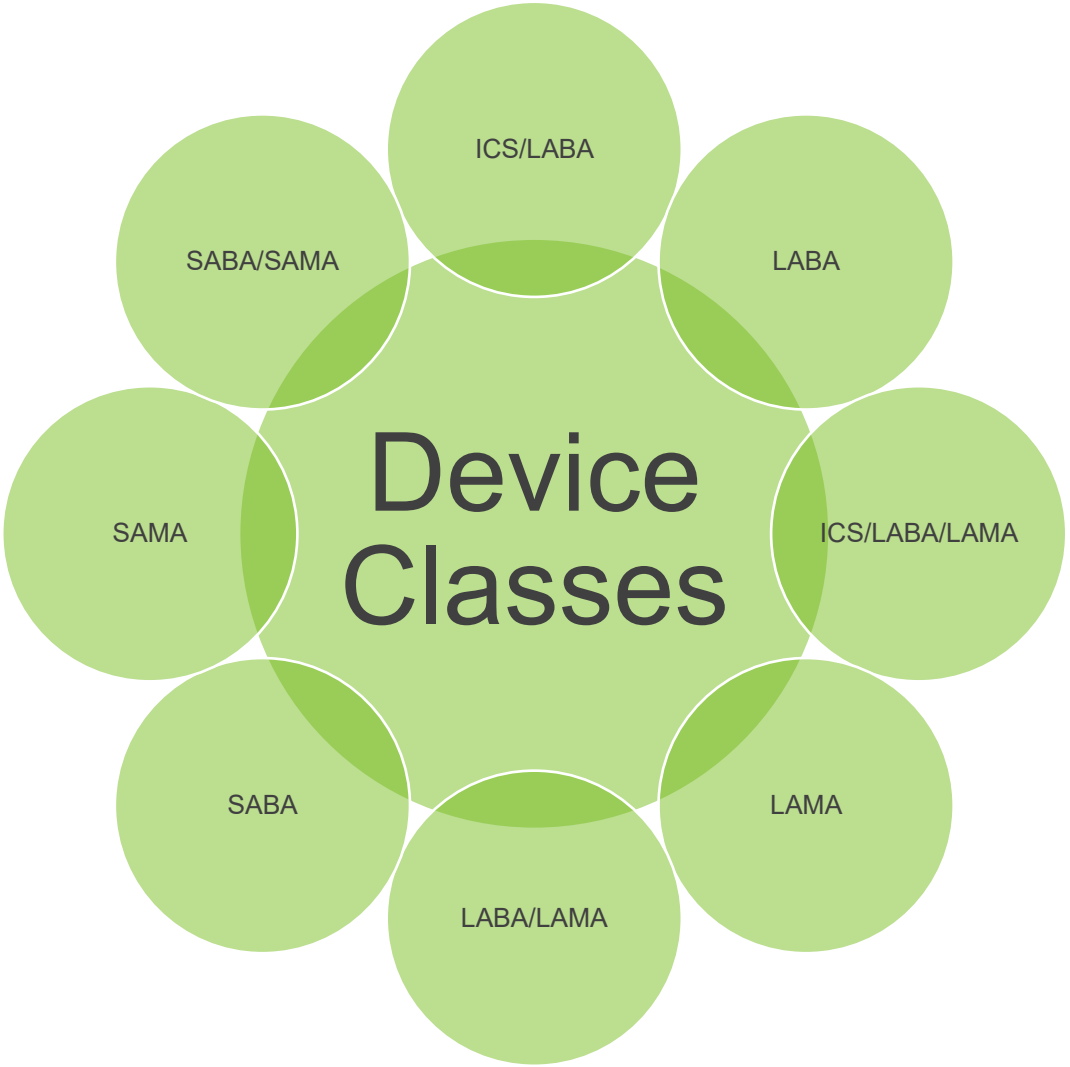


Drug Class Review



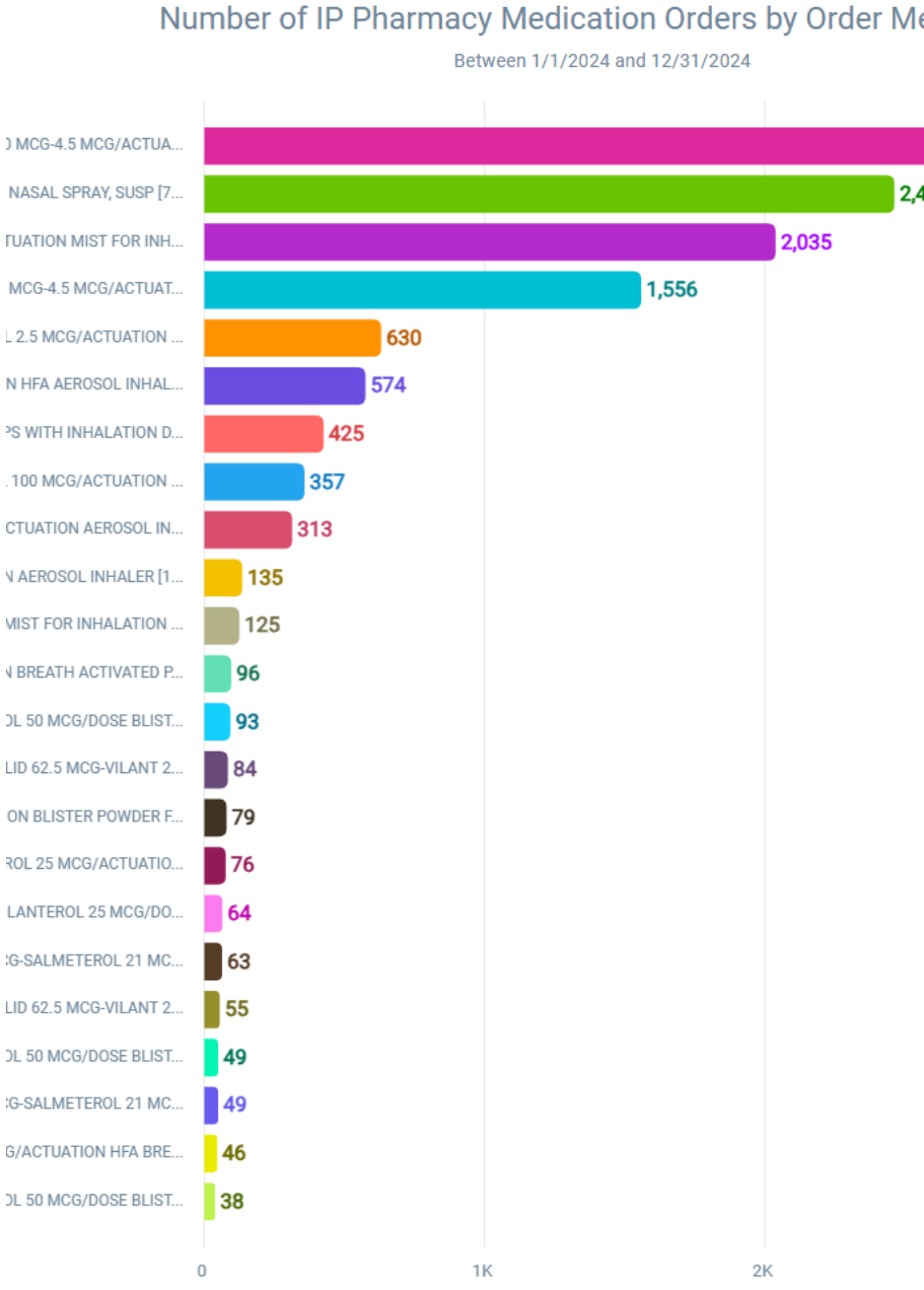
Economic Analysis

- Identify any products by class at lowest cost
  - Institutional-sized packaging
  - Manufacturer contracts
  - Nebulization versus device
  - Combinations of devices



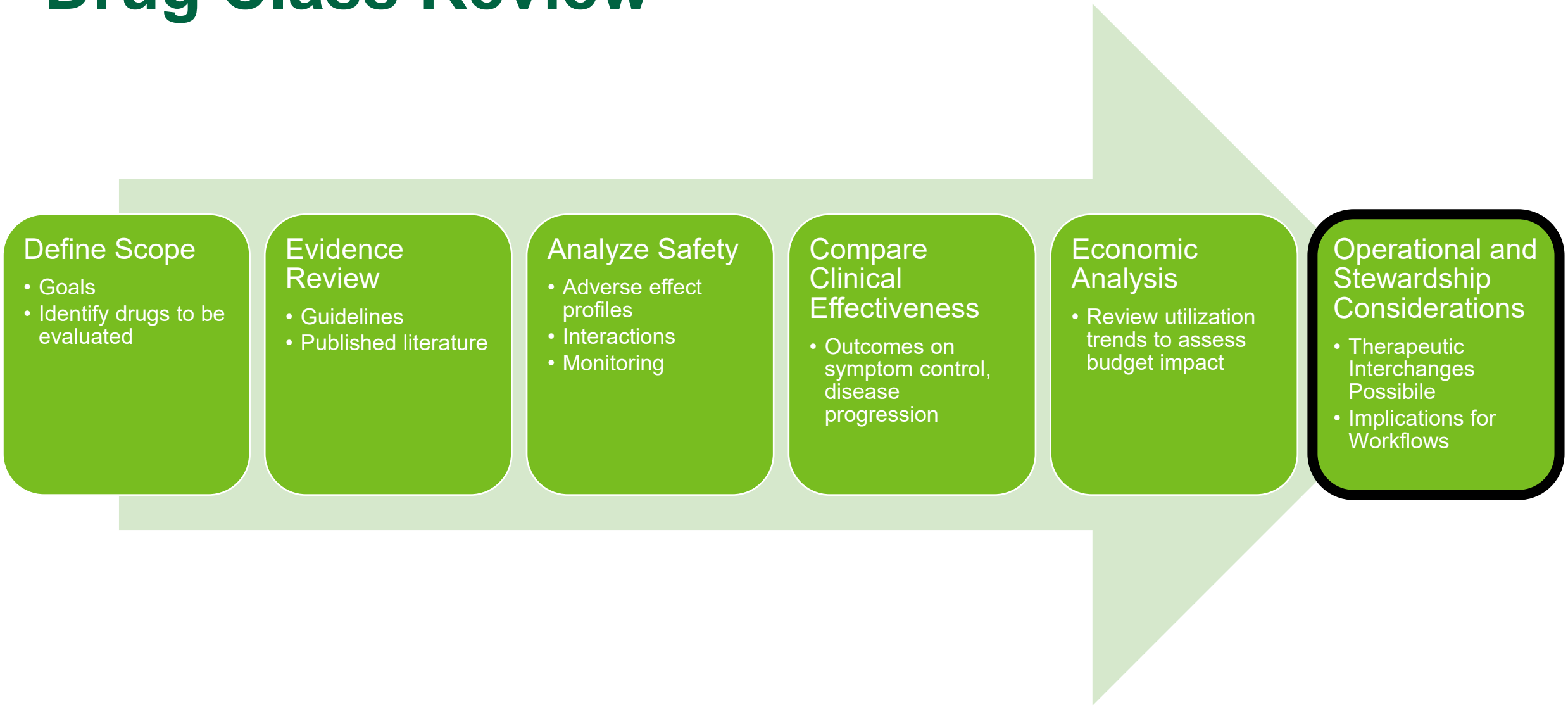
Economic Analysis

- Historic usage
  - Examine dispense versus usage
    - Ipratropium and ipratropium/albuterol
  - Olodaterol
    - 181 dispenses over a year
      - Predominantly to create a LAMA/LABA maintenance regimen
    - Design regimens based on expected usage
      - Formoterol nebulization
      - Add LAMA/LABA maintenance inhaler



University of Vermont Health

Drug Class Review



Therapeutic Interchange

Inhaled Corticosteroid (ICS) Ages 12 and Older		
Low Dose ICS		
Ordered Product	**Total Daily Dose** (mcg/day)	**Formulary Agent**
Beclomethasone HFA	80-240	**Mometasone DPI** DPI 220 mcg, 1 inhalation nightly *or* **Mometasone HFA*** 200 mcg, 1 inhalation nightly
Budesonide DPI	<400	
Ciclesonide HFA	80-160	
Fluticasone propionate HFA	88-264	
Fluticasone propionate DPI	100-300	
Fluticasone furoate DPI	100	
Medium Dose ICS		
Ordered Product	**Total Daily Dose** (mcg/day)	**Formulary Agent**
Beclomethasone HFA	>240-480	**Mometasone DPI** DPI 220 mcg, 1 inhalation twice daily *or* **Mometasone HFA*** 200 mcg, 1 inhalation twice daily
Budesonide DPI	>400-800	
Ciclesonide HFA	>160-320	
Fluticasone propionate HFA	>264-440	
Fluticasone propionate DPI	>300-500	
High Dose ICS		
Ordered Product	**Total Daily Dose** (mcg/day)	**Formulary Agent**
Beclomethasone HFA	>480 mcg	**Mometasone DPI** DPI 220 mcg, 2 inhalations twice daily *or* **Mometasone HFA*** 200 mcg, 2 inhalations twice daily
Budesonide DPI	>800	
Ciclesonide HFA	>320	
Fluticasone propionate HFA	>440	
Fluticasone propionate DPI	>500	
Fluticasone furoate DPI	200	

*HFA reserved for patients without appropriate technique or unable to receive DPI formulation

Therapeutic Interchange

Inhaled Corticosteroid (ICS) Ages ≤ 11		
Ordered Product	**Total Daily Dose** (mcg/day)	**Formulary Agent Dosing Regimen**
Beclomethasone HFA	40	**Mometasone HFA** 50 mcg once daily
	80	**Mometasone HFA** 50 mcg BID
	160	**Mometasone HFA** 100 mcg BID
	320	**Mometasone HFA** 200 mcg BID
Budesonide DPI	180	**Mometasone HFA** 50 mcg BID
	360	**Mometasone HFA** 100 mcg BID
	720	**Mometasone HFA** 200 mcg BID
Ciclesonide HFA	80	**Mometasone HFA** 50 mcg BID
	160	**Mometasone HFA** 100 mcg BID
	320	**Mometasone HFA** 200 mcg BID
Fluticasone propionate HFA	88	**Mometasone HFA** 50 mcg BID
	110	**Mometasone HFA** 100 mcg once daily
	176	**Mometasone HFA** 100 mcg BID
	≥220	**Mometasone HFA** 200 mcg BID
Fluticasone propionate DPI	100	**Mometasone HFA** 50 mcg BID
	200	**Mometasone HFA** 100 mcg BID
	400	**Mometasone HFA** 200 mcg BID
Fluticasone furoate DPI	50	**Mometasone HFA** 50 mg once daily
	100	**Mometasone HFA** 50 mcg BID
	200	**Mometasone HFA** 100 mcg BID

Therapeutic Interchange

Long-Acting Beta-Agonists (LABA)	
Ordered Product	**Formulary Agent**
Salmeterol 50 mcg	**Formoterol nebulizer 20 mcg/2 mL** One nebulizer twice daily
Olodaterol 2.5 mcg	

Long-Acting Muscarinic-Antagonists (LAMA)	
Ordered Product	**Formulary Agent**
Umeclidinium 62.5 mcg	**Tiotropium soft mist inhaler** 2.5 mcg 2 inhalations once daily
Tiotropium 18 mcg	
Aclidinium 400 mcg	

Long-Acting Muscarinic-Antagonist/Long-Acting Beta Agonist (LAMA/LABA)	
Ordered Product	**Formulary Agent**
Aclidinium/Formoterol 400mcg/12mcg	**Tiotropium/Olodaterol soft mist inhaler** 2.5 mcg/2.5 mcg 2 inhalations once daily
Glycopyrolate/Formoterol 9 mcg/4.8 mcg	
Umeclidinium/Vilanterol 62.5mcg/25 mcg	

Therapeutic Interchange

Inhaled Corticosteroid/Long-Acting Beta-Agonist (ICS/LABA) Therapeutic Interchange	
Ordered Product	**Formulary Agent**
Mometasone/Formoterol 50 mcg/5 mcg 100 mcg/5 mcg	**Budesonide/Formoterol** 80 mcg/4.5mcg 2 puffs twice daily
Fluticasone/Salmeterol 100 mcg/50 mcg 250 mcg/50 mcg	
Fluticasone/Salmeterol 45 mcg/21 mcg 115 mcg/21 mcg	
Fluticasone/Salmeterol 55 mcg/14 mcg 113 mcg/14 mcg	
Fluticasone/Vilanterol 100 mcg/25 mcg	
Mometasone/Formoterol 200 mcg/5 mcg	**Budesonide/Formoterol** 160 mcg/4.5mcg 2 puffs twice daily
Fluticasone/Salmeterol 500 mcg/50 mcg	
Fluticasone/Salmeterol 230 mcg/21 mcg	
Fluticasone/Salmeterol 232 mcg/14 mcg	
Fluticasone/Vilanterol 200 mcg/25 mcg	

Therapeutic Interchange

ICS/LAMA/LABA	
Ordered Product	**Formulary Agent Combination**
Fluticasone/Umeclidinium/Vilanterol 100 mcg/62.5 mcg/25 mcg	**Budesonide/Formoterol** 80 mcg/4.5mcg 2 puffs twice daily WITH **Tiotropium** 2.5 mcg 2 inhalations once daily
Fluticasone/Umeclidinium/Vilanterol 200 mcg/62.5mcg/25 mcg	**Budesonide/Formoterol** 160 mcg/4.5mcg 2 puffs twice daily WITH **Tiotropium** 2.5 mcg 2 inhalations once daily
Budesonide/Formoterol/Glycopyrolate 160 mcg/9 mcg/4.8mcg	

Therapeutic Interchange

- SAMA/SABA combination
  - Ipratropium/albuterol nebulization solution as formulary agent
- SAMA
  - Ipratropium nebulization solution as formulary agent

Interchange:

- Ipratropium/Albuterol 20-100 mcg to Ipratropium/Albuterol 0.5-2.5 mg/3 mL nebulizer solution **at same interval**
- Ipratropium MDI 17 mcg to Ipratropium 0.5 mg/2.5 mL nebulizer solution **at same interval**

Electronic Health Record Updates

- EHR medication records need to be updated/built
  - Barcode medication administration
- Automate transitions of care to facilitate interchange
- Update order sets where non-formulary products may live
- Update clinic-administered workflows

Education

- Post-P&T Education
  - Update Drug Information Resources (Internal and Tertiary if used)
  - P&T Newsletter and website
  - Prepare staff for change
    - Reengage Stakeholders for their expertise and direct access to impacted staff
    - Staff Meetings
    - Email

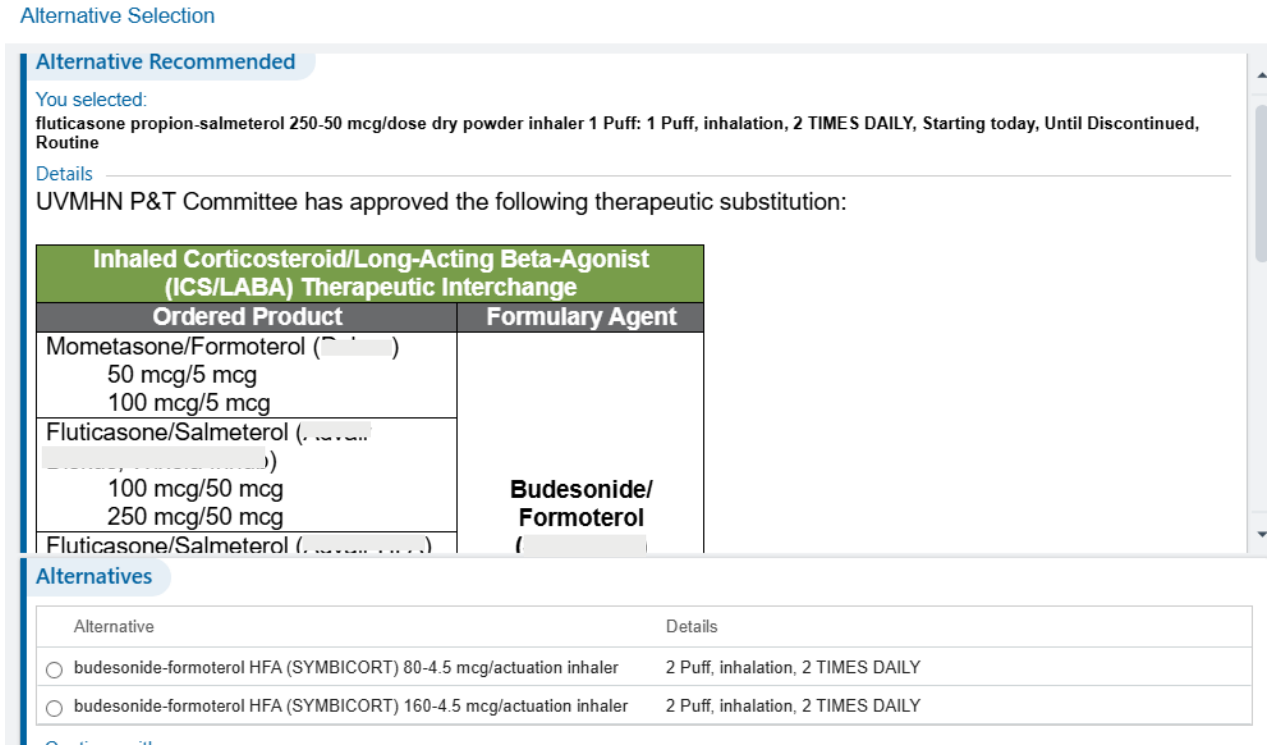
Go-Live and Impact

Go-Live

- Make updates as seamless as possible for end users
  - Plan needed for updates to active orders
  - Engage point of contacts across system and departments
- Supply chain
  - Get supply ready and removed products pulled back (versus depleting existing stock)
  - Stock automated dispensing cabinets where appropriate
  - Other supplies such as nebulization equipment

Workflow Implications

- An estimated 60% of medication errors occur during transitions of care
  - Exchanging and sharing information between care teams
- Admission:


Alternative Selection

Alternative Recommended

You selected:

fluticasone propion-salmeterol 250-50 mcg/dose dry powder inhaler 1 Puff: 1 Puff, inhalation, 2 TIMES DAILY, Starting today, Until Discontinued, Routine

Details

UVMHN P&T Committee has approved the following therapeutic substitution:

Inhaled Corticosteroid/Long-Acting Beta-Agonist (ICS/LABA) Therapeutic Interchange	
Ordered Product	**Formulary Agent**
Mometasone/Formoterol (Dulera) 50 mcg/5 mcg 100 mcg/5 mcg	**Budesonide/ Formoterol**
Fluticasone/Salmeterol (Advair Diskus, Wixela Inhub) 100 mcg/50 mcg 250 mcg/50 mcg	
Fluticasone/Salmeterol (Advair HFA)	

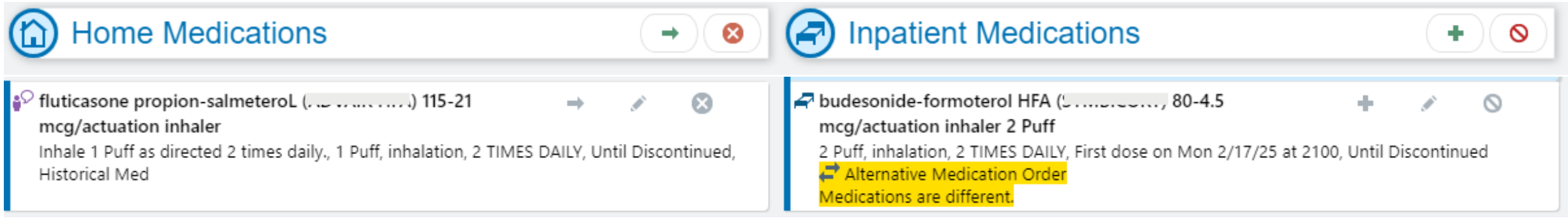
Alternatives

Alternative	Details
budesonide-formoterol HFA (SYMBICORT) 80-4.5 mcg/actuation inhaler	2 Puff, inhalation, 2 TIMES DAILY
budesonide-formoterol HFA (SYMBICORT) 160-4.5 mcg/actuation inhaler	2 Puff, inhalation, 2 TIMES DAILY

Satake A, McElroy V. Inpatient Transitions of Care: Challenges and Safety Practices. PSNet [internet]. Rockville (MD): Agency for Healthcare Research and Quality, US Department of Health and Human Services. 2024.

Workflow Implications

- Discharge:



Impact

- Greenhouse Gas Emissions
  - Reducing HFA use with formulary agents reduced CO2 equivalent of **over 11 metric tons**
- A step towards UVMMC Sustainability Certification through The Joint Commission

2.6 gas-powered vehicles over 1 year

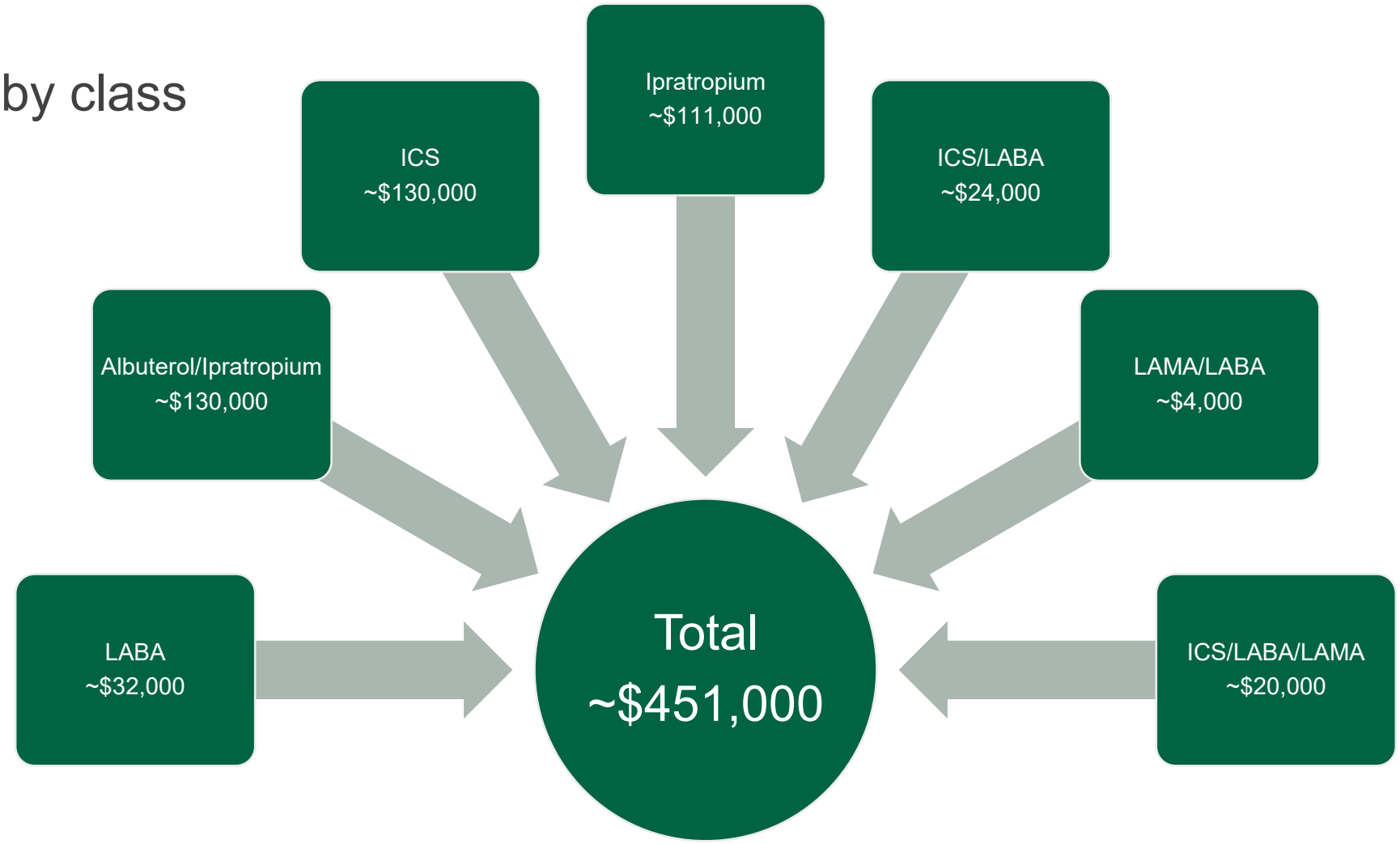
28,012 miles driven by gas-powered car

12,219 pounds of coal burned

1.5 houses of energy use for 1 year

Impact

- Savings by class



Impact

- Provide a framework for interchanges in the future
  - Further reductions in GHG emissions
  - Alternative products available
  - Drug shortages
- Education
  - Streamlined education approach

Conclusions

- Assessment of current practice can drive change in formulary management
- Interdisciplinary engagement and planning through P&T can create safe and efficacious strategies to provide inhaled therapies that is easily replicated
- Impacts of this work can improve environmental impact, sustainability, and cost for organizations

Thank you team!

- Jeff Endicott, PharmD – Clinical Pharmacy Manager, UVMMC
- Diane Imrie, RD, MBA – System Director of Sustainability
- Brad Holcomb, RRT – Manager Respiratory Care, UVMMC
- Emily Parent, RRT – Supervisor Respiratory Care, UVMMC
- Chris Chambers, RRT – Supervisor Respiratory Care, UVMMC
- Cara Grogan, RRT – Respiratory Educator, UVMMC
- Stacy Dalpoas, PharmD, MHA – System Director of Clinical Pharmacy
- Michele Corriveau, Rph – Director of Pharmacy Services, UVMMC
- Grant Martin, PharmD – Epic Willow Analyst

Questions