

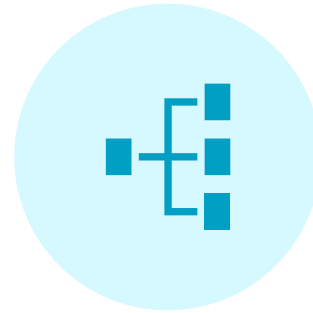
Decarbonizing Care Delivery Quality Improvement Workbook

Lowering Emissions from Anesthetic Gases

How to Use the Workbook



Use this workbook to guide your organization's improvement projects related to lowering emissions from anesthetic gases.



Each section describes setting up a core element of a quality improvement project.



In each section, there is a blank tool template that you can customize for your specific project.



You may want to save your customized tools in a separate file to share with key stakeholders as your project progresses.



Model for Improvement

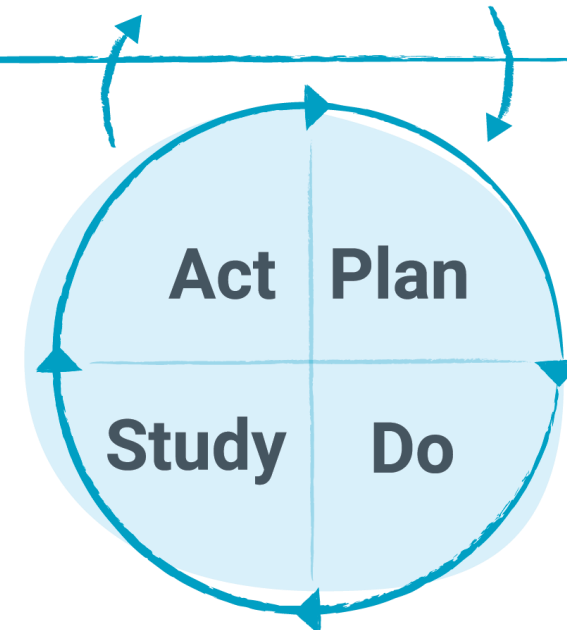
- The tools in this slide deck are based on the Model for Improvement.
- Answer the 3 questions in any order you choose.
- We advise setting the aim for your improvement project before selecting measures or changes.

Model for Improvement

What are we trying to accomplish?

How will we know that a change is an improvement?

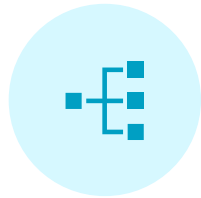
What change can we make that will result in improvement?



Tools in the Workbook



Aim Statement
Worksheet



Driver Diagram
Template



Key Change
Ideas Tracker



Plan, Do, Study,
Act (PDSA)
Planning Form



PDSA Ramp
Planning
Worksheet



Measurement
Strategy
Worksheet



1. Aim Statement Worksheet

What are we trying to accomplish?



Aim Statement: Overview

An aim statement is the answer to the first question in the Model for Improvement, “What are we trying to accomplish?” The aim statement communicates your project’s ambition and timeframe.

Effective aim statements delineate clear, specific plans for the work ahead and clarity on the intended improvements to the system.

The prompts on the next page will help you write an effective aim statement to reduce emissions from anesthetic gases in service of net zero carbon goals.

The checklist will help you to identify opportunities to strengthen the aim statement.

Example Aim Statement Worksheet:

Eliminating Desflurane at Northern Light Health

What? What's the problem or opportunity?

Northern Light Health primarily uses three different anesthetic gases, desflurane, isoflurane, and sevoflurane, all with significantly different global warming potentials.

Desflurane is the most environmentally harmful anesthetic gas in use across our system, with a global warming potential (GWP₁₀₀) of 2540. Other gasses are clinically acceptable and yield substantially less greenhouse gas emissions.

How much? By how much will you improve? Or "how good" do you want to get?

Eliminate desflurane use

By when? What is the date by which you will achieve the level of improvement you've set out to accomplish?

The end of the fiscal year (September 2024)

Where? What are the boundaries of the process or system you're trying to improve? Where does it begin and end?

Starting with Eastern Maine Medical Center then scaling to all hospitals within Northern Light Health.

Complete aim statement:

To reduce our carbon footprint with the long-term goal of net zero emissions, we will eliminate the use of desflurane in anesthesia care across the Northern Light Health system by September 2024.

Ask a colleague to check your work and recommend improvements:

- Is the problem or opportunity clearly stated?
- Do you know what the team is going to do about the problem?
- Has the team set a numerical goal to quantify the amount of improvement they'd like to make?
- Do you know the calendar date by which the team plans to achieve the goal?
- Is it clear who will benefit from the improvement?
- Is the scope of the project clear?
- Do you know why this improvement effort is important?



Example Aim Statement Worksheet:

Decommissioning Central Nitrous Oxide (N2O) at Stanford Health Care (SHC)

What? What's the problem or opportunity?

Transition nitrous oxide (N2O) delivery systems from a centrally piped system to an E-cylinder delivery system, starting with one pilot site, then expanding to all facilities.

N2O is an inhaled anesthetic commonly used in medical settings. N2O is a potent greenhouse gas, as it has a global warming potential 265 times that of carbon dioxide (CO2). Any N2O emitted today will remain in the atmosphere for approximately 100 years. N2O alone is responsible for 23.7 percent of Scope 1 GHG emissions at our health system main campus. Purchase data versus electronic health record use data on patients shows less than 9.5 percent of purchased N2O is used on patients – thus more than 90% is being lost through leakage through the centrally piped system.

How much? By how much will you improve? Or “how good” do you want to get?

Reduce emissions from N2O by at least 90 percent

By when? What is the date by which you will achieve the level of improvement you've set out to accomplish?

The end of the year

Where? What are the boundaries of the process or system you're trying to improve? Where does it begin and end?

At pilot SHC facility site in Redwood City, CA. Effort will be scaled to other SHC facilities in the future after the pilot.

Complete aim statement:

To lower emissions from nitrous oxide (N2O) by >90%, decommission the centrally piped N2O system and transition to an E cylinder delivery system by end of 2023 at a pilot SHC facility with plans to scale to other SHC facilities in the future.

Ask a colleague to check your work and recommend improvements:

- Is the problem or opportunity clearly stated?
- Do you know what the team is going to do about the problem?
- Has the team set a numerical goal to quantify the amount of improvement they'd like to make?
- Do you know the calendar date by which the team plans to achieve the goal?
- Is it clear who will benefit from the improvement?
- Is the scope of the project clear?
- Do you know why this improvement effort is important?



Tool Template: Aim Statement Worksheet

What? What's the problem or opportunity?

How much? By how much will you improve? Or "how

By when? What is the date by which you will achieve the level of improvement you've set out to accomplish?

Where? What are the boundaries of the process or system you're trying to improve? Where does it begin and end?

Complete aim statement:

Ask a colleague to check your work and recommend improvements:

- Is the problem or opportunity clearly stated?
- Do you know what the team is going to do about the problem?
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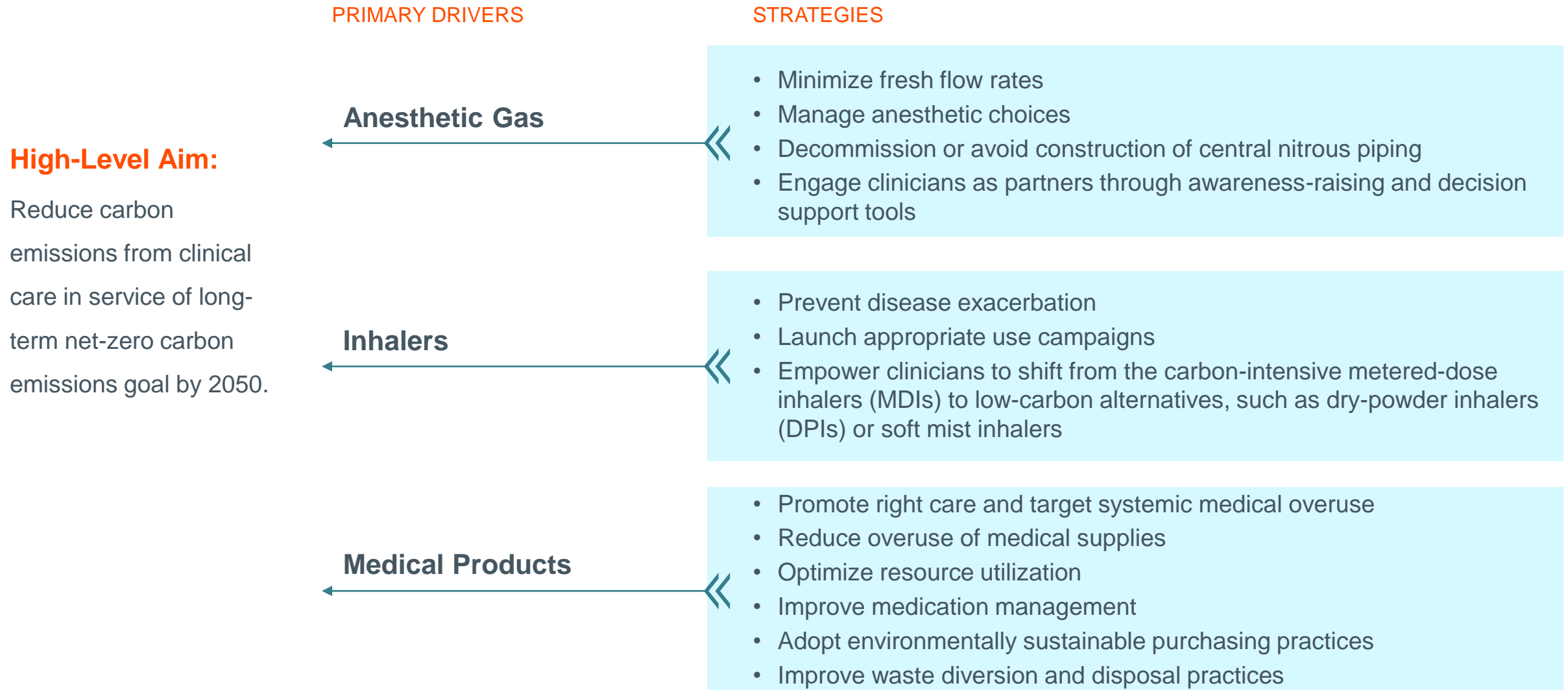
2. Driver Diagram Template

What changes can we make that will result in improvement?

Driver Diagram: Overview

- To achieve your aim, the team should have a strong theory about what will lead to the intended improvement. Driver diagrams are one method to share your theory about how you'll achieve your aim.
- A driver diagram shows the relationship between the overall **aim** of the project and the **primary drivers** and **secondary drivers** that contribute directly to achieving the aim.
- When developing a driver diagram, enlist team members familiar with different aspects of the system you intend to improve, and subject matter experts. One individual is unlikely to have a clear view of an entire complex system.

Decarbonizing Care Driver Diagram

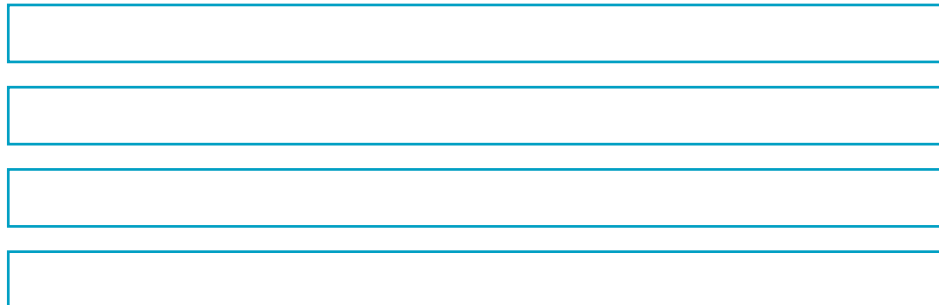
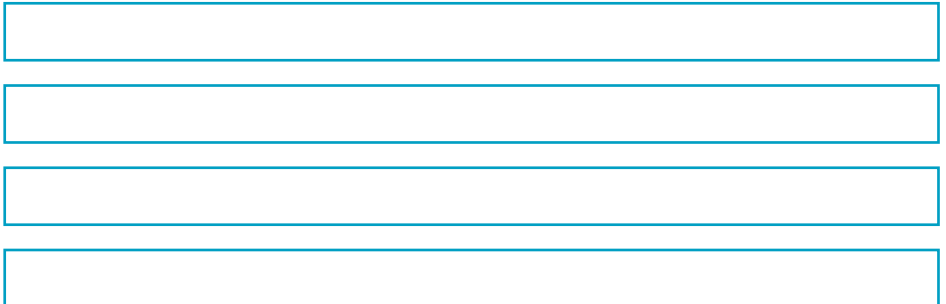
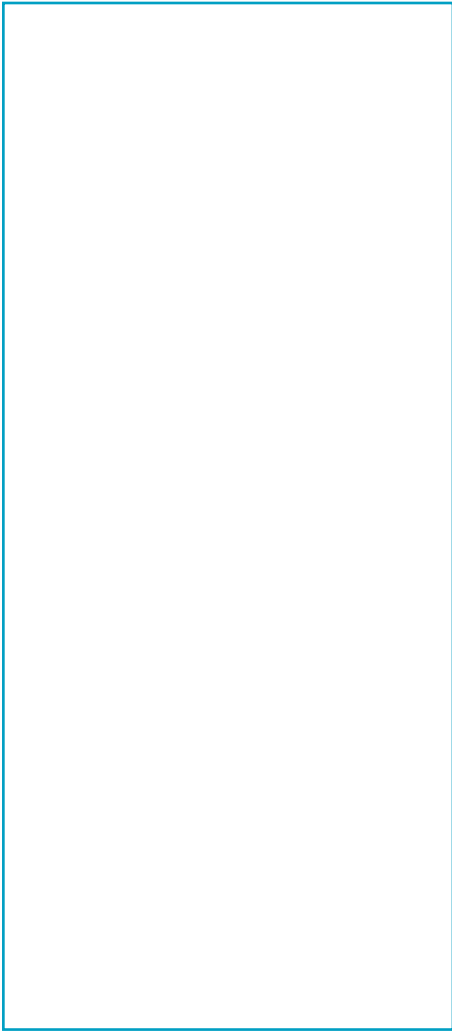


Tool Template: Driver Diagram

Aim

Primary Drivers

Secondary Drivers



3. Change Ideas Tracker

What changes can we make that will result in improvement?



Change Ideas: Overview

- Change ideas: Specific, identifiable changes that will bring about improvement, that will lead you in a desirable direction toward achieving your aim.
- Testing a change idea on a small scale using Plan-Do-Study-Act (PDSA) cycles enables trial and learning, minimizes risks, and helps team observe how the system or process responds to the change.
- As you learn from a change, continue testing and use data acquired from the change and defined measures to track your progress.
- Using PDSA cycles, develop subsequent tests and refinements in the change idea to build confidence in the change.

Change Ideas: Overview

- This section gives you an opportunity to do a quick check on the current status of key change ideas for reducing emissions from anesthetic gases.
- You can then plan which ideas you will test and implement next.
- The first table is a completed example, followed by a blank table template.

Example Change Ideas: Anesthetic Gases

Strategies	Change Ideas	Not Yet Tested	Plan to Test	Testing	Implemented
Minimize fresh flow rates	Lower default fresh gas flow settings				X
Manage anesthetic choices	Replace desflurane with sevoflurane or isoflurane, eventually reducing or removing desflurane from formularies			X	
	Transition to Total Intravenous Administration (TIVA) where possible	X			
Decommission or avoid construction of central nitrous piping	Substitute central nitrous piping – which can leak at rates of 90 percent – with portable E-cylinders		X		
	Ensure nitrous oxide tanks are closed between usage to avoid leaks		X		
Engage clinicians as partners through awareness-raising and decision support tools	Enlist anesthesiologists to champion this work			X	
	Use real-time data from EHR to inspire healthy competition		X		
	Offer regular feedback to anesthesia groups with customized emissions data, lowest emitters, industry benchmarks, and tips on how to decrease emissions		X		
	Implement provider guidance into clinical workflow such as vaporizer labels at the point of decision-making, greenhouse gas footprint to order entry, or “traffic light” color-coding system to indicate environmental impacts	X			
	Offer education on reducing emissions from anesthetic gases to existing employee trainings, presentations, and rounds				X



Tool Template: Change Ideas

Strategies	Change Ideas	Not Yet Tested	Plan to Test	Testing	Implemented
Minimize fresh flow rates	Lower default fresh gas flow settings				
Manage anesthetic choices	Replace desflurane with sevoflurane or isoflurane, eventually reducing or removing desflurane from formularies				
	Transition to Total Intravenous Administration (TIVA) where possible				
Decommission or avoid construction of central nitrous piping	Substitute central nitrous piping – which can leak at rates of 90 percent – with portable E-cylinders				
	Ensure nitrous oxide tanks are closed between usage to avoid leaks				
Engage clinicians as partners through awareness-raising and decision support tools	Enlist anesthesiologists to champion this work				
	Use real-time data from EHR to inspire healthy competition				
	Offer regular feedback to anesthesia groups with customized emissions data, lowest emitters, industry benchmarks, and tips on how to decrease emissions				
	Implement provider guidance into clinical workflow such as vaporizer labels at the point of decision-making, greenhouse gas footprint to order entry, or “traffic light” color-coding system to indicate environmental impacts				
	Offer education on reducing emissions from anesthetic gases to existing employee trainings, presentations, and rounds				

4. PDSA Planning Sheet

What changes can we make that will result in improvement?



PDSA Cycles: Overview

As part of the Model for Improvement, **Plan-Do-Study-Act (PDSA)** cycles are a useful tool to test and document change ideas.

Plan: Develop a plan to test the change

Do: Carry out the test

Study: Observe, analyze, and learn from the test

Act: Determine what modifications, if any, to make for the next PDSA cycle

PDSA Cycles: Overview

PDSA cycles are a good way to:

- Test change ideas on a small scale initially to understand the effect of a change on a system or process to ensure the change is leading to the desired result.
- Using multiple PDSA cycles, a team can test, refine, and adapt change ideas to the environment while gaining staff buy-in.

PDSA Planning Sheet: Desflurane Example

Act: Based on what you learned from the test, make a plan for your next step

Determine what modifications you should make: adapt, adopt, or abandon

- **Adopt:** Upon realizing the environmental impact of desflurane, some anesthesiologists decided to adopt more sustainable practices, such as using alternative anesthetics with lower global warming potential like sevoflurane and isoflurane. Team will continue with campaign of awareness through emails/meetings/results sharing to engage and involve more anesthesiologist. Team will also evaluate results of survey to understand barriers or concerns from some anesthesiologists to switch to alternative anesthetics.

Study: Analyze the results and compare them to your predictions.

Summarize and reflect on what you learned

- As the team predicted, making anesthesiologists aware of the environmental impact of desflurane led to a more conscious decision on which anesthetic gas to use during an intervention.
- Also, some anesthesiologists choose to advocate for change within their professional community and raise awareness among colleagues.

Plan: Plan the test, including a plan for collecting data

- **Question:** Will sharing information with an anesthesiologist about the environmental impact of desflurane (GWP 2540) lead to lower use of this anesthetic gas?
- **Prediction:** Anesthesiologist may choose to use alternative anesthetics that have a lower environmental impact, like sevoflurane and isoflurane.

Who, what, where, when

The anesthesiologist manager/lead will send an email with details about the environmental impact of desflurane to all the anesthesiologists in her organization on 10/17/23. Team ensured that other anesthetics gases were available in ORs.

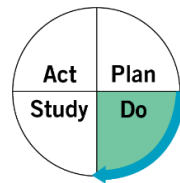
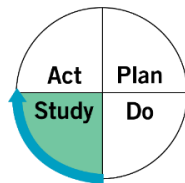
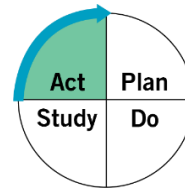
Plan for collecting data

- Sustainability manager will collect data about the number of surgeries where desflurane, sevoflurane and isoflurane was used. This data is currently collected per surgery and per anesthesiologist.

Do: Run the test

Describe what happened. What data did you collect? What observations did you make?

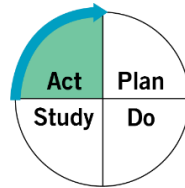
- Team was able to collect 4 weeks' worth of data after email was sent.
- At the same time, team sent a questionnaire to anesthesiologist to understand why they use desflurane and if there are barriers for them to switch to other anesthetics gases.



Tool Template: PDSA Planning Sheet

Act: Based on what you learned from the test, make a plan for your next step

Determine what modifications you should make: adapt, adopt, or abandon



Plan: Plan the test, including a plan for collecting data

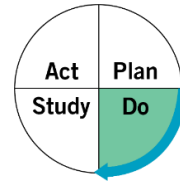
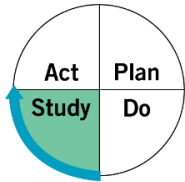
Questions and Predictions

Who, what, where, when

Plan for collecting data

Study: Analyze the results and compare them to your predictions.

Summarize and reflect on what you learned



Do: Run the test on a small scale

Describe what happened. What data did you collect?
What observations did you make?



5. PDSA Ramp Planning Worksheet

What changes can we make that
will result in improvement?



PDSA Ramps: Testing Changes and Scaling Up Tests

- **Start small**

When testing changes, it is important to start small – but don't stay there very long! With each test, predict what you will do if the test works so that you continue to move the work forward.

- **Scale up tests by multiples of 5**

A common sequence for testing is to start with 1 patient, then move to 5 patients, then 25 patients, etc.

- **Test under a wide range of conditions.**

An example of a PDSA ramp using this sequence is provided in this workbook.

PDSA Ramps: Testing Changes and Scaling Up Tests

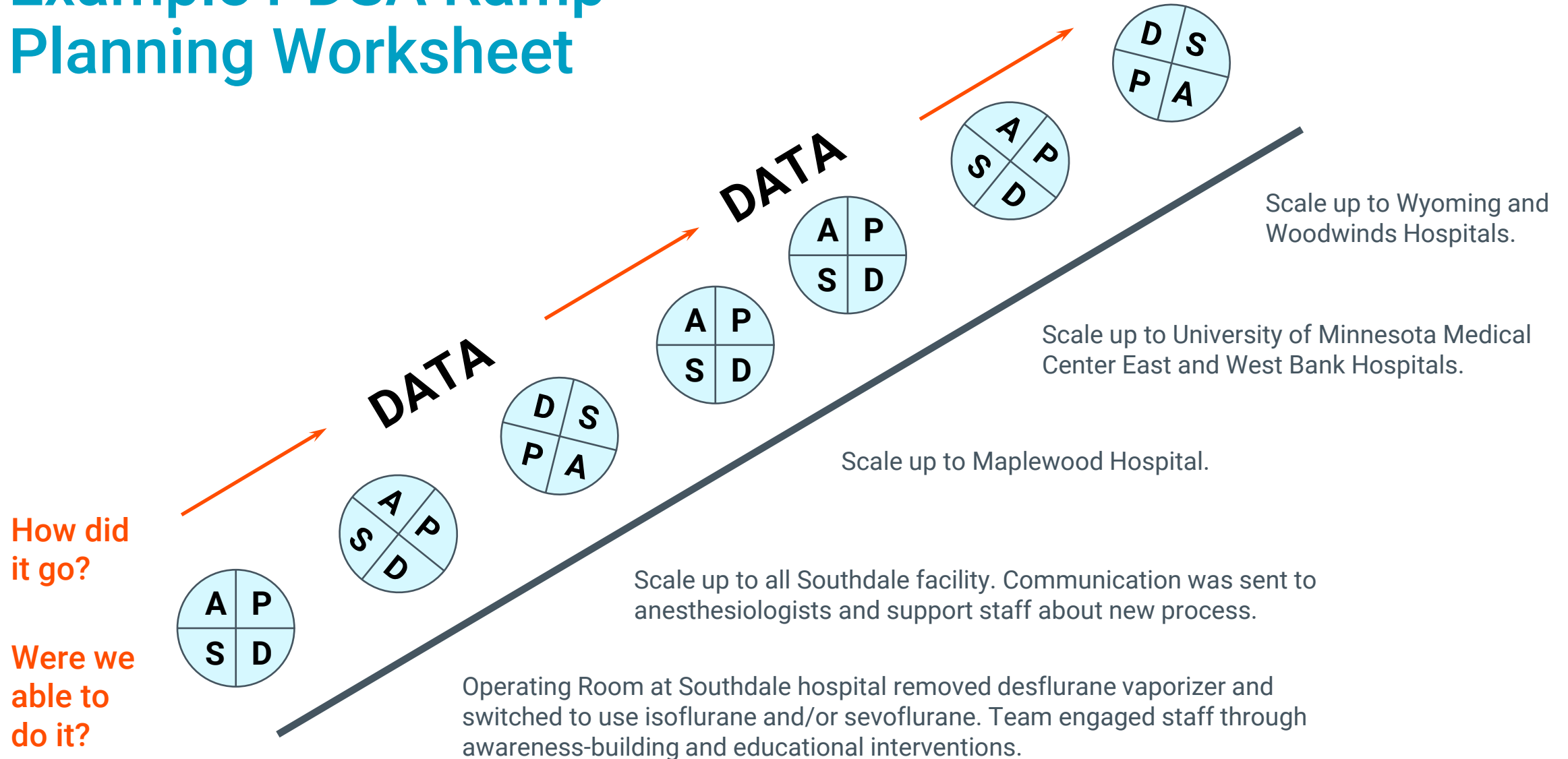
After each PDSA cycle, decide if you should:

- Implement the change as is (adopt the change idea)
- Drop the change entirely (abandon the change idea)
- Modify and test again (adapt the change idea)
- Increase in scope (expand the change idea)
- Test the change idea under other conditions

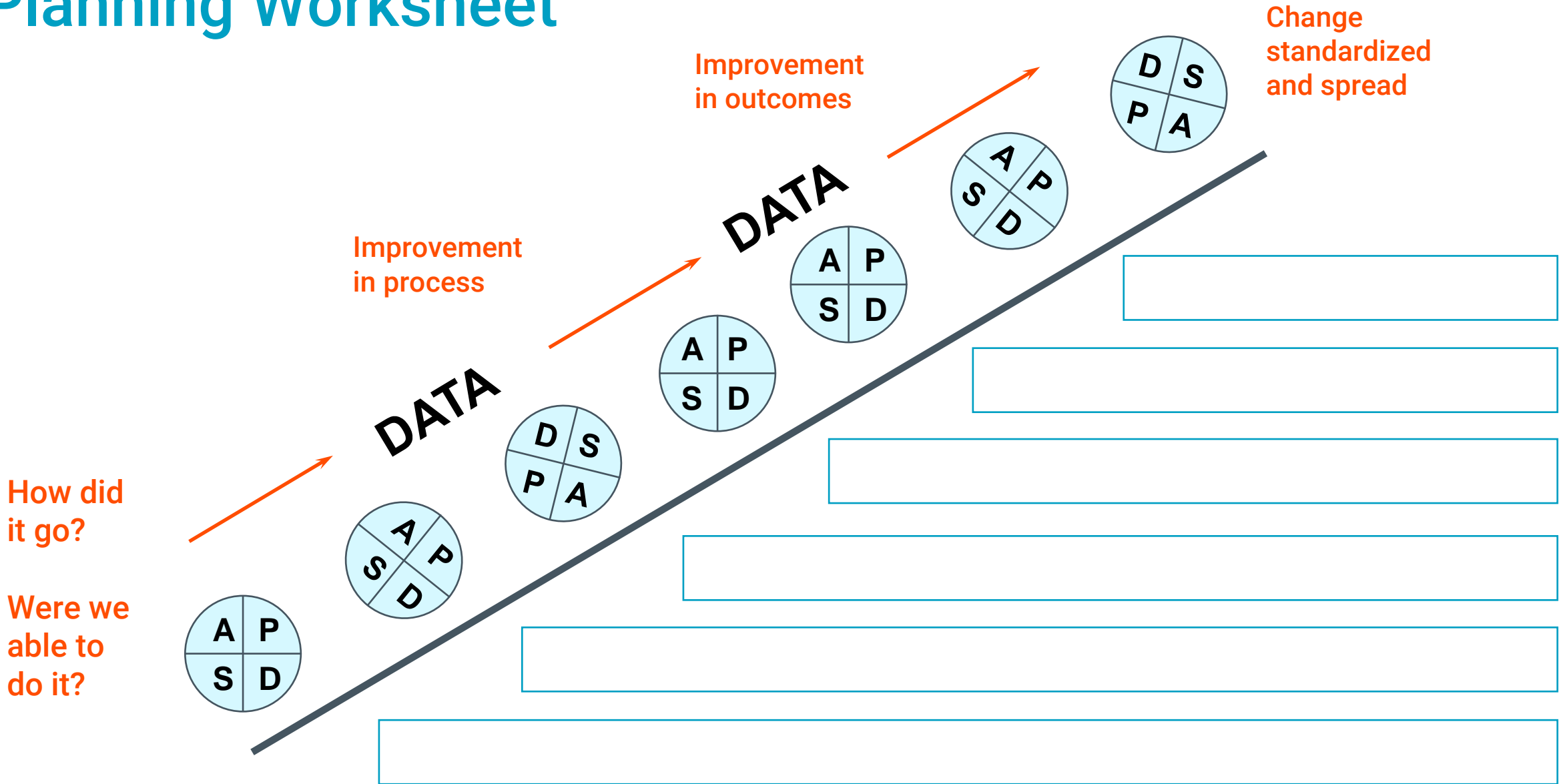
When should you implement a change?

- When you have a reliable process; there is nothing more that needs to be learned for the change to operate as planned
- There is evidence of improvement (quantitative and qualitative)
- You have local champions for the change
- The change idea has been tested under a variety of conditions
- The cost of failure is low or mitigated

Example PDSA Ramp Planning Worksheet



Tool Template: PDSA Ramp Planning Worksheet



6. Measurement Strategy Template

How will we know that a change is
an improvement?

Measures Overview

Measures help you know if you are on track to achieve your aim, answering the question, **“How will we know that a change is an improvement?”**

It is important to have a balanced set (or family) of measures to track progress.

There are three types of measures for improvement: outcome, process, and balancing measures.

Define each measure and develop a clear plan for data collection and reporting.



Three Types of Measures for Improvement

Measure Type	Characteristics	Recommended Number
Outcome	<ul style="list-style-type: none">• Voice of the customer or patient• How is the system performing?• What is the result? “so what” measure• Always links back to your aim	1–2
Process	<ul style="list-style-type: none">• Voice of the workings of the system• Are the parts/steps in the system performing as planned?<ul style="list-style-type: none">○ Can be an early indication of improvement in the outcome○ Careful not to overdo the number	3–5
Balancing	<ul style="list-style-type: none">• Looking at a system from different directions/dimensions• Looks at the impact a change may have on other parts of the system<ul style="list-style-type: none">○ Unintended consequences○ Upstream/downstream• Optional, but wise to include	1–2



Example Measurement Strategy Worksheet:

Reducing Desflurane

Aim Statement: To reduce our carbon footprint with the long-term goal of net zero emissions, we will eliminate the use of desflurane in anesthesia care across the Northern Light Health system by September 2024.

Measure Type	Measure
Outcome	Overall reduction in greenhouse gas emissions attributable to anesthetic gases
Process	Purchase of desflurane by volume Use of desflurane
Balancing	Increase in Post Anesthesia Care Unit (PACU) recovery time for patients



Example Measurement Strategy Worksheet:

Decommissioning Central Nitrous Oxide (N₂O) at Stanford Health Care (SHC)

Aim Statement: To lower emissions from nitrous oxide (N₂O) by >90%, decommission the centrally piped N₂O system and transition to an E-cylinder delivery system by end of 2023 at a pilot SHC facility with plans to scale up efforts to other SHC facilities in the future.

Measure Type	Measure
Outcome	Reduction in emissions from leakage of N ₂ O
Process	Purchases of N ₂ O Usage data of N ₂ O from electronic health record
Balancing	Patient access to N ₂ O E-cylinders Storage capacity for E-cylinders



Tool Template: Measurement Strategy

Aim Statement:

Measure Type	Measure
Outcome	
Process	
Balancing	

