

King Saud University
College of Business Administration
Department of Health Administration - Masters` Program

HHA 524 Health Economics
Second Semester 1442/ 1443

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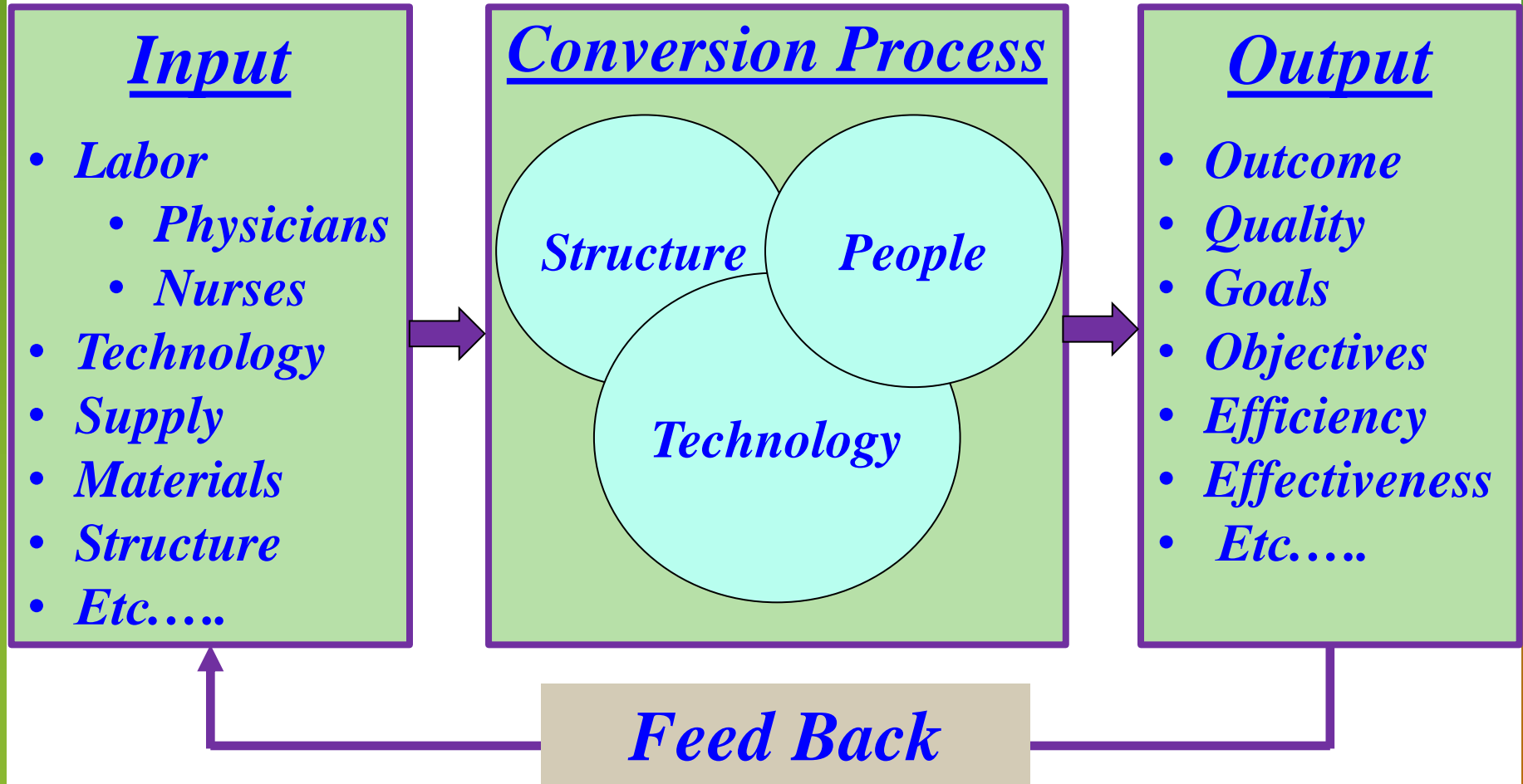
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THE PRODUCTION OF HEALTH-RELATED GOODS AND SERVICES

Learning Objectives

- *Describe the issues involved in choosing the best input combinations to produce a particular output.*
- *Summarize the role that technology has in healthcare production and its effect on cost.*
- *Explain how the marginal product of inputs is related to total profit.*
- *Describe the relationship between short-run marginal cost and the marginal productivity of the variable inputs.*
- *Differentiate the issues associated with long-run and short-run production.*

Exhibit 4.1 The production of health—both at the individual and population levels—is no different from other production processes in that inputs are combined to produce a specific output.



THE PRODUCTION OF HEALTH-RELATED GOODS AND SERVICES

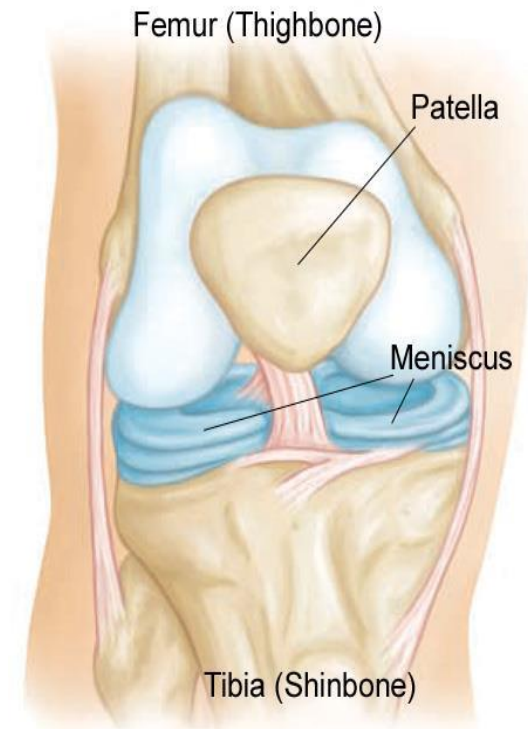
Health Output

- *Understanding the production of health-related goods and services begins with identifying the output.*
- *A health output can be as simple as a physical exam or as complex as treatment for cancer.*
- *This output is achieved by combining various inputs.*

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Health Output

- *To better appreciate the relationship between inputs and output in health production, consider as an example the treatment of a torn **meniscus** (the pieces of cartilage between the bones that come together to form the knee joint).*



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Health Output

- *The output (after a medical intervention) is an intact knee. The meniscus's job is to cushion and stabilize the knee joint.*
- *A torn meniscus can be treated in many ways, but not all treatments are recommended for every-one.*
- *Surgery and physical therapy have both been shown to be good interventions.*
- *Surgery requires a set or combination of health inputs, including a surgeon, an anesthesiologist, a surgical suite, surgical instruments, and preoperative tests.*

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Health Output

- *Physical therapy also involves a set of inputs, such as a physical therapist, a therapy assistant, and bracing.*
- *Each input or combination of inputs has a cost.*
- *Thus, the cost of treating a torn meniscus with surgery is different from the cost of treating the injury with physical therapy.*
- *In addition to costs, other differences between inputs exist that may cause the output to vary from one producer to the next.*

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Health Output

- *Consider another output—a comprehensive physical exam. The input combinations could be a physician and a medical assistant or a solo nurse practitioner.*
- *Each input combination can produce the desired output, but that output will not be identical.*
- *For example, the time spent on the various elements of the exam will vary by provider type:*
- *Unlike the physician (who typically has an assistant to handle routine tasks), the nurse practitioner may spend more time taking the patient's medical history.*

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Health Output

- *Each combination of inputs has advantages and disadvantages.*
- *Some combinations of inputs are cost prohibitive from the individual's or insurer's perspective.*
- *Other combinations are socially undesirable or inefficient from a time management perspective.*
- *Examining the substitutability between inputs is an essential element of health production.*

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Input Substitution

- *Substitution refers to the replacement of one input of production with another input.*
- *A substitution of a medical professional may be done by replacing the person with another professional who is trained, qualified, and capable of performing the same tasks.*
- *For example, a nurse practitioner and a family practitioner are both trained to complete a well-baby checkup.*

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Input Substitution

- *Sometimes, substitution of a medical input is not possible.*
- *For example, only a physician can perform certain medical procedures, such as neurosurgeries.*
- *At other times, input combinations can be replaced with myriad other combinations to achieve a similar output.*

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Marginal Product and Diminishing Returns

- *One key concept in choosing the ideal quantity and mix of inputs is the law of diminishing returns (as inputs to production are used in higher quantities, their effect on the output decreases).*
- *For example, suppose a physician practice moves into a larger office suite and thus has more exam rooms than its previous location afforded.*

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Marginal Product and Diminishing Returns

- *Due to budget constraints, the practice does not hire any additional medical assistants.*
- *However, the office manager of the practice believes that with additional medical assistants, the practice can be more efficient, serve more patients, and make a higher profit.*
- *Other personnel are not so sure about the manager's assumptions.*

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Marginal Product and Diminishing Returns

- In theory, when an input increase—medical assistants, in this case—the following could result:*
 - 1. More patients are served.*
 - 2. Fewer patients are served.*
 - 3. The number of patients served does not change.*
- Exhibit 4.2 shows the number of medical assistants and the number of patients they can serve per day.*

Exhibit 4.2 shows the number of medical assistants and the number of patients they can serve per day.

<i>Number of Medical Assistants</i>	<i>Total Physical Product (Number of Patients)</i>	<i>Marginal Product</i>	<i>Average Product</i>
<i>0</i>	<i>0</i>		
<i>1</i>	<i>4</i>	<i>4</i>	<i>4</i>
<i>2</i>	<i>12</i>	<i>8</i>	<i>6</i>
<i>3</i>	<i>27</i>	<i>15</i>	<i>9</i>
<i>4</i>	<i>36</i>	<i>9</i>	<i>9</i>
<i>5</i>	<i>40</i>	<i>4</i>	<i>8</i>
<i>6</i>	<i>42</i>	<i>2</i>	<i>7</i>
<i>7</i>	<i>42</i>	<i>0</i>	<i>6</i>
<i>8</i>	<i>40</i>	<i>-2</i>	<i>5</i>

THE PRODUCTION OF HEALTH-RELATED GOODS AND SERVICES

Marginal Product and Diminishing Returns

- *But a more informative measure is the change in the number of patients served when more medical assistants are added.*
- *That change in output that results from adding one unit of input is called the marginal product.*
- *Average product is also helpful, but to a lesser extent; information on incremental production decisions is only obtained with marginal product.*

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Marginal Product and Diminishing Returns

- The data in Exhibit 4.1 show that marginal product initially increases when more medical assistants are employed, but then it decreases.*
- The marginal product of extra medical assistants is maximized when the third assistant is hired.*
- Thereafter, the additional output from more medical assistants falls, although the number of patients served (total physical product or output) continues to rise until the sixth medical assistant is hired.*
- The term that economists use for this phenomenon is diminishing returns.*

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Marginal Product and Diminishing Returns

Simply put, more inputs can mean more output, but the change in output declines. Diminishing returns in production occur for a few reasons:

- 1. Increases in factors of production (such as labor) may not bring efficiency when other inputs (such as capital) are not also increased. The same can be said for increases in capital. If labor is not also increased, the capital expansion may not reach its full production potential.*

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Marginal Product and Diminishing Returns

Diminishing returns in production occur for a few reasons:

- 2. Resources used in producing one type of good or service may not be as efficient (or productive) when transferred to the production of another good or service. As a result, the marginal product of the input is not as high as it would be in a different setting.*

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Relationship Between Marginal Product and Profit

- Profit is the total revenue that a firm takes in minus the total costs of production.*
- If the firm is able to produce more without increasing its production costs, profits will increase.*
- The total cost remains the same if the number of employees, wages, and the capital infrastructure (e.g., technology) do not change.*

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Relationship Between Marginal Product and Profit

KEY FORMULA

- *Total revenue (TR) = Price × Quantity*
- *Total profit = Total revenue – Total cost*
- *Profit The difference between total revenue and total cost.*
- *Total Cost The sum of total fixed costs and total variable costs.*

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Relationship Between Marginal Product and Profit

- *This Equation suggests, total profit can grow when prices increase, quantity increases, or total costs decrease.*
- *If the assumption is that prices and quantity cannot change, then holding costs down is the only avenue by which profits will increase.*
- *Assuming that prices of health-related goods and services do not change in the short run is not unreasonable.*

THE PRODUCTION OF HEALTH-RELATED GOODS AND SERVICES

Relationship Between Marginal Product and Profit

- Suppose a radiology office currently sees ten patients per day for CAT scans (a specialized type of X-ray that stands for computerized axial tomography).***
- If the office can maintain the same costs and see 12 patients per day, then its profits will increase. The addition of two patients per day means greater profit for the office.***

Exhibit 4.2. *If the firm can produce more without increasing its production costs, profits will increase.*

The total cost remains the same if the number of employees, wages, and the capital infrastructure (e.g., technology) do not change.



THE PRODUCTION OF HEALTH-RELATED GOODS AND SERVICES

Technology and Production

- *Technology is used in all areas of healthcare. As a rule, the term medical technology refers to the procedures, equipment, and processes by which healthcare providers diagnose, treat, and monitor health conditions.*
- ***Examples** include medical and surgical procedures (e.g., angioplasty, endoscopic surgery), pharmaceuticals (e.g., protease inhibitors for treatment of HIV), medical devices (e.g., magnetic resonance imaging [MRI] machine, vascular stent), and support systems (e.g., electronic medical records)*

THE PRODUCTION OF HEALTH-RELATED GOODS AND SERVICES

Technology and Production

- *Technology plays a large role in the productivity of inputs. **For example**, an ambulatory surgical center may be able to increase the volume of patients it serves by offering a short-acting general anesthetic.*
- *This intervention may reduce the duration of patient recovery, which frees up providers' time to see additional patients.*

THE PRODUCTION OF HEALTH-RELATED GOODS AND SERVICES

Technology and Production

- Such technological advances in medicine may reduce the number of employees needed to generate the same level of output.*
- Of course, new technology may necessitate workers to be retrained*
- In general, medical technology can have a ripple effect on the processes, costs, and output throughout a healthcare organization.*

THE PRODUCTION OF HEALTH-RELATED GOODS AND SERVICES

Technology Adoption

- *Two basic motivations typically drive a healthcare organization's adoption of technology: profit and patient well-being.*
- *Adoption tends to occur when the present value of future profits attributed to the innovation is above a threshold that is financially workable for the company.*
- *If the technology brings in more patients or lowers healthcare delivery costs, profits may increase.*

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Technology Adoption

- Of course, new technology may be adopted simply because it improves the well-being of patients.*
- Providers that are not early adopters may initially lose patients to those that embrace technology from the start.*
- Patients and other healthcare consumers are attracted to providers that have the latest technology.*
- Late adopters, however, may avoid the problems associated with a new-technology rollout.*

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Technology Adoption

Many people assume that older providers are averse to new technology. Although that may be true for some, it does not apply to all clinicians. In determining the acquisition of new technology, providers take certain factors into consideration:

- 1. Does the clinician work solo or is she part of a group practice? A group practice may have the financial means that a solo practitioner lacks.*

THE PRODUCTION OF HEALTH-RELATED GOODS AND SERVICES

Technology Adoption

- 2. Is the clinician close to retirement age? Those who plan to retire in a few years may not invest in expensive technology because the return on investment is far in the future.***
- 3. To what extent is the technology linked to the clinician's day-to-day tasks? Physicians may not embrace the latest technology if it is only marginally beneficial to the work they and their staff do on a daily basis. Adopting technology just for the sake of having it is not a good justification for such an expensive purchase.***

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Technology and Managed Care

- Decreasing the use of expensive technology (e.g., specialty care, advanced imaging) that has minimal or questionable benefit is of particular interest to many healthcare leaders.*
- Managed care has historically used the gatekeeping system and preapproval process to curtail the use of costly services.*
- Thus, the slow MRI adoption in hospital markets that have high levels of managed care is not surprising.*

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Cost and Production

- *Providers—whether for-profit or not-for-profit—care about the cost of producing a good or service.*
- *These costs cut into total revenue and thus affect total profit.*
- *Both for-profit and not-for-profit entities make a profit. What they do with that profit differs, however.*
- *For-profit businesses distribute profits to shareholders, while not-for-profits reinvest profits back into the firm.*

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Fixed and Variable Costs

- *Costs are generally classified as variable or fixed and as short run or long run.*
- *Fixed costs include loans or leases (which are constant over a specified period), and fixed employee contracts.*
- *Fixed costs do not change when the amount of output produced changes. (in Total Not on Average)*
- *For example, a hospital makes a monthly payment to lease its MRI machine. The hospital must pay the lease whether or not patients are using the machine.*

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Short-run and Long-run Costs

- *Note that economic costs are different from standard accounting costs.*
- *Economic costs are the sum of accounting costs and the opportunity cost of using resources.*
- *Variable and fixed costs are evaluated within the context of time—specifically, the short run and the long run.*

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Short-run and Long-run Costs

- *Cost is considered short run when the cost of at least one input to production is fixed (e.g., rent, contract).*
- *Conversely, cost is considered long run when all inputs to production are variable.*
- *In the long run, a producer can make bigger production decisions.*
- *For example, a hospital may grow by adding a new service (e.g., cancer treatment center) or by upgrading to large-scale technology.*

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Cost Calculations

Example Total Fixed and Average Fixed Costs

- *Exhibit 4.3 shows a hypothetical firm's total fixed cost of \$60,000 per month; that is, the firm (say, a multispecialty group practice) pays \$60,000 in bills regardless of the amount of output produced (say, number of patients served).*
- *As production increases, the fixed cost is spread over a higher number of output units, so the average fixed cost declines.*

Exhibit 4.3 shows an Example Total Fixed and Average Fixed Costs

<i>Out Put Unit</i>	<i>Total Fixed Cost (TFC)</i>	<i>Average Fixed Cost (AFC)</i>
<i>0</i>	<i>\$ 60,000</i>	
<i>100</i>	<i>\$ 60,000</i>	<i>\$ 600</i>
<i>200</i>	<i>\$ 60,000</i>	<i>\$ 300</i>
<i>300</i>	<i>\$ 60,000</i>	<i>\$ 200</i>
<i>400</i>	<i>\$ 60,000</i>	<i>\$ 150</i>
<i>500</i>	<i>\$ 60,000</i>	<i>\$ 120</i>
<i>600</i>	<i>\$ 60,000</i>	<i>\$ 100</i>

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Short-Run and Marginal Costs

In Exhibit 4.4, output is the number of patients and total fixed cost is composed of the practice administrator's monthly salary and the monthly rent for the office space.

The total variable cost is a medical assistant's wage or some other input that is not fixed over a specified period.

The marginal cost is the change in total cost that results from the production of one more unit of output.

Exhibit 4.4, the marginal cost initially decreases, but then it increases when output reaches 120 units. **Short-run Cost of Production**

Out Put Unit	Total Fixed Cost (TFC)	Total Variable Cost (TVC)	Total Cost (TC) TFC+TVC	Average Total Cost (ATC) TC / Q	Marginal Cost $\Delta TC/\Delta Q$
0	\$ 60,000	0	\$ 60,000		
20	\$ 60,000	\$ 400	\$ 60,400	\$ 3,020.00	\$ 20
40	\$ 60,000	\$ 600	\$ 60,600	\$ 1,515.00	\$ 10
60	\$ 60,000	\$ 740	\$ 60,740	\$ 1,012.30	\$ 7
80	\$ 60,000	\$ 840	\$ 60,840	\$ 760.50	\$ 5
100	\$ 60,000	\$ 900	\$ 60,900	\$ 609.00	\$ 3
120	\$ 60,000	\$ 1,040	\$ 61,040	\$ 508.70	\$ 7
140	\$ 60,000	\$ 1,380	\$ 61,380	\$ 438.40	\$ 17
160	\$ 60,000	\$ 1,880	\$ 61,880	\$ 386.80	\$ 25
180	\$ 60,000	\$ 2,600	\$ 62,600	\$ 347.80	\$ 36
200	\$ 60,000	\$ 3,600	\$ 63,600	\$ 318.00	\$ 50

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Short-Run and Marginal Costs

- As shown in Exhibit 4.4, the marginal cost initially decreases, but then it increases when output reaches 120 units.*
- This makes intuitive sense, because each additional (marginal) input is increasingly more productive; however, at some point the law of diminishing returns kicks in and additional inputs become less productive.*
- One reason this can happen is that more fixed inputs are needed for the variable inputs to be productive*

THE PRODUCTION OF HEALTH-RELATED GOODS AND SERVICES

Economies of Scale and Economies of Scope

- *Firms can make major changes in the scale and scope of production in the long run.*
- *Examples of these kinds of changes include leasing or buying a larger production facility, expanding into a new line of business, or purchasing new technology.*
- *In economics, scale is a synonym for size.*
- *Economies of scale, The reduction in long-run average and marginal costs attributed to an increase in size of an operating unit*

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Economies of Scale and Economies of Scope

- *Often, when firms grow in size, they experience a decrease in long-run average total cost.*
- *This relationship between **scale of production** and declining average total cost is called **economies of scale**.*
- *For example, if a hospital doubles in size, it may be able to attain economies of scale and thus serve more than double the number of patients.*

As Exhibit 4.5 illustrates, as output increases dramatically there is a decrease in long-run average total cost.

<i>Output Units (Q)</i>	<i>Total Cost (TC)</i>	<i>Average Cost TC/Q</i>
<i>2,000</i>	<i>\$8,500</i>	<i>\$4.25</i>
<i>4,000</i>	<i>\$15,000</i>	<i>\$3.75</i>
<i>10,000</i>	<i>\$36,000</i>	<i>\$3.60</i>
<i>20,000</i>	<i>\$65,000</i>	<i>\$3.25</i>
<i>40,000</i>	<i>\$120,000</i>	<i>\$3.00</i>
<i>100,000</i>	<i>\$280,000</i>	<i>\$2.80</i>
<i>200,000</i>	<i>\$490,000</i>	<i>\$2.45</i>

THE PRODUCTION OF HEALTH-RELATED GOODS AND SERVICES

Economies of Scale and Economies of Scope

- *Economies of scope is an economic concept that refers to the decrease in the total cost of production when a range of products are produced together rather than separately.*
- *Another concept related to scale is economies of scope, which occur when two or more goods are produced jointly rather than separately and thus reducing total costs.*

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Economies of Scale and Economies of Scope

- *By definition, economies of scope are possible only for firms that offer multiple products.*
- *Because many healthcare entities (e.g., academic health centers) are multiproduct in nature, economies of scope are a natural outgrowth.*
- *Consider, for example, a hospital that expands its services by building a cancer center, a heart center, and an ambulatory surgical center—in that order.*

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Economies of Scale and Economies of Scope

- With the addition of the cancer center, the hospital experiences declining average costs as the hospital and the cancer center share many of the same administrative resources.*
- However, the addition of the heart center and ambulatory surgical center brings to the entire operation a new level of complexity and thus additional costs. When this happens, efficiency shrinks and average total cost increases.*

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Summary Points

- *Increases in inputs to production (e.g., labor) may not be as efficient when other inputs (e.g., capital) are not also increased.*
- *Resources used in producing one type of good or service may not be as efficient (or productive) when transferred to the production of another good or service.*
- *In the long run, when all costs become variable, a producer can make bigger production decisions.*
- *Technological advancement can lead to a change in cost structure and production.*
- *Often, when firms grow in size, they experience a decrease in long-run average total cost.*
- *Because many healthcare entities offer multiple products, economies of scope are a natural outgrowth.*



THANK YOU