



BACKGROUND

Student Engagement

- Flipped classroom models incorporating case-based learning may improve student learning^{1,2}
- Engaging every learner through sample patient cases in a large classroom format remains a challenge
- Interactive digital patient cases (eCases) allow self-paced individual practice in clinical decision-making skills³
- eCases were developed as optional content instruction to supplement the mandatory course materials in a cardiovascular (CV) therapeutics course starting in 2020, with revisions and improvements made yearly

eCase Implementation in a Cardiovascular Therapeutics Module

- Each eCase included patient scenarios representing various subsets of disease
- Iterations:** Each eCase generated a patient case based on a predetermined scenario with randomly generated patient variables (e.g. blood pressure)
- Treatment selection:** Students were tasked to choose treatment or adjust regimens with immediate and specific feedback provided
- Unlimited attempts:** Students could attempt each eCase as often as desired for additional feedback or to achieve success across multiple predetermined scenarios
- Use of the eCases was encouraged by course faculty, but was not linked to a grade incentive

Figure 1. Characteristics of eCases used in CV Therapeutics Module⁴

	Hypertension (HTN)	Venous Thrombo-embolism (VTE)	Acute Heart Failure (AHF)
Randomization	Low	Very High	High
Possible Outcomes	3	5	>10
Average Uses/Student	1.3	4.5	12

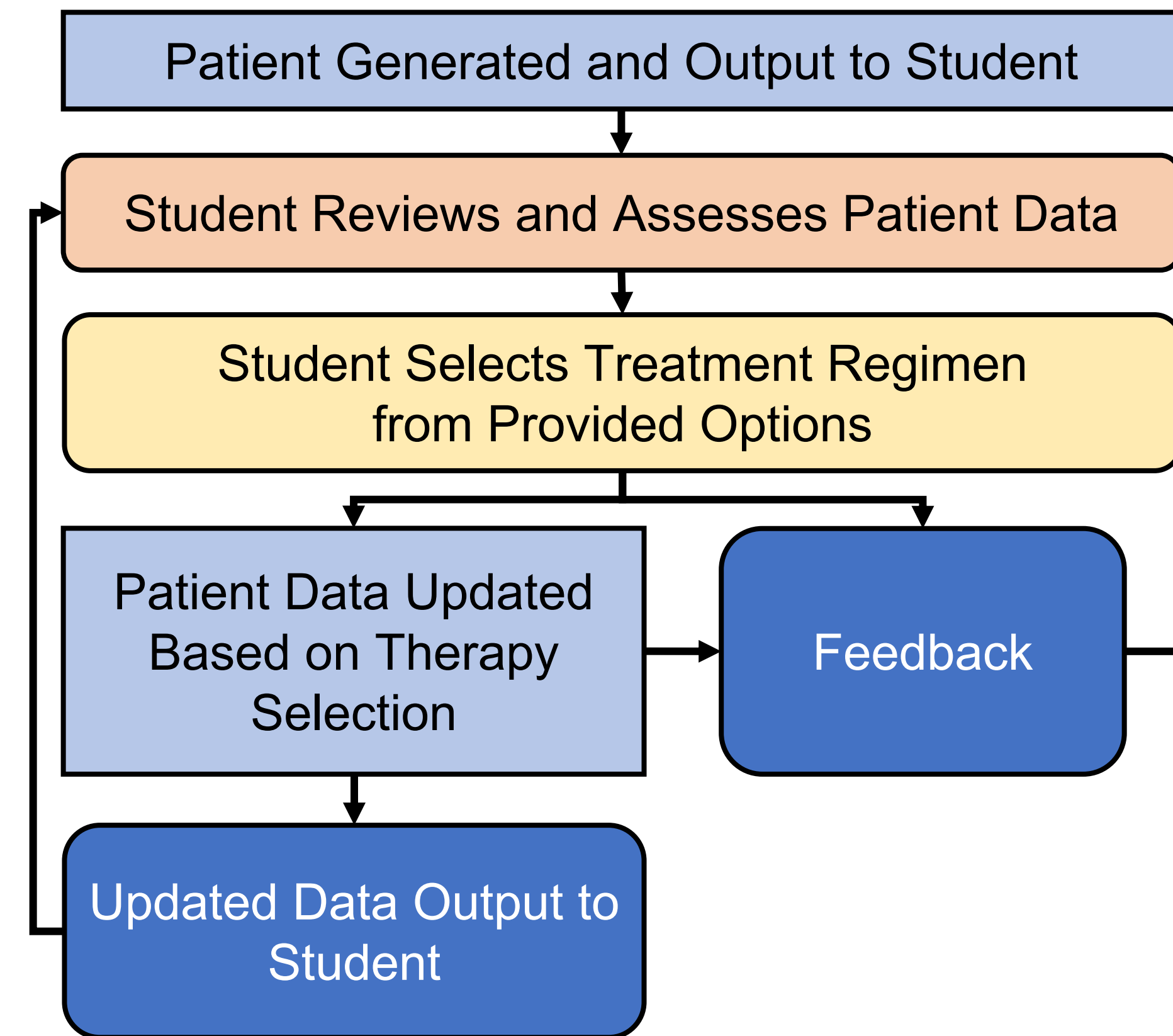


Figure 2: General Flow of eCase.

Students assess and choose therapy for randomly generated patients within a subset of disease. Immediate feedback is provided to the student based on their choices and they are allowed to re-attempt the same eCase. In certain eCases, the patient may evolve through several iterations before final feedback is provided to the student.

OBJECTIVES

To evaluate the impact of eCase use on student pharmacist performance in a cardiovascular therapeutics course

METHODS

- Retrospective, observational study from Fall 2020 through Fall 2022
- PharmD students who enrolled in and completed the cardiovascular therapeutics course were included
- Students grouped by any use of an eCase
- eCase use characteristics collected:
 - User
 - Unique patient: each iteration of an eCase
 - Attempt: complete progression through an iteration
 - Success: success criteria met for a single attempt
- Individual student performance metrics collected:
 - Overall course score
 - Midterm and final exam scores
 - Content-specific exam question scores
- Mann-Whitney and chi-square tests used for comparisons

RESULTS

Overall Course and Exam Performance

Table 1: Exam and Course Performance by eCase Usage

Year	Characteristic	eCase Users	eCase Non-Users	p-value
2020	n	123	76	
	Course, mean (SD)	91.08 (5.61)	91.84 (5.30)	0.302
	Midterm, mean (SD)	92.66 (7.04)	94.30 (5.94)	0.132
	Final, mean (SD)	70.98 (8.10)	71.51 (7.85)	0.653
2021	n	112	81	
	Course, mean (SD)	85.89 (6.96)	85.36 (6.41)	0.611
	Midterm, mean (SD)	78.21 (10.55)	78.23 (10.07)	0.951
	Final, mean (SD)	78.04 (9.74)	75.01 (10.27)	0.045
2022	n	94	76	
	Course, mean (SD)	83.60 (8.14)	79.67 (8.96)	0.002
	Midterm, mean (SD)	75.86 (12.57)	73.82 (13.11)	0.296
	Final, mean (SD)	74.99 (11.88)	67.68 (12.51)	<0.001

Table 2: Student eCase Usage by Quartile of Performance

Year	Characteristic	Q1, n/N (%)	Q4, n/N (%)	p-value
2020	Course	34/50 (68.0)	30/50 (60.0)	0.405
	Midterm	34/46 (73.9)	30/50 (60.0)	0.149
	Final	33/49 (67.3)	32/51 (62.7)	0.630
2021	Course	28/48 (58.3)	30/48 (62.5)	0.676
	Midterm	29/46 (63.0)	30/48 (62.5)	0.957
	Final	24/48 (50.0)	32/48 (66.7)	0.098
2022	Course	19/42 (45.2)	27/42 (64.3)	0.079
	Midterm	22/45 (48.9)	25/44 (56.8)	0.454
	Final	15/43 (34.9)	26/37 (70.3)	0.002

Q1 represents students in the 25th percentile and Q4 represents students in the 75th percentile. N represents the total number of students in each quartile, with n representing the number of students that used an eCase.

Content-Specific Exam Item Performance

Table 3: Performance on HTN Exam Questions by HTN eCase Usage

Year	Characteristic	HTN eCase Users	HTN eCase Non-Users	p-value
2020	n	88	111	
	% Correct, mean (SD)	70.31 (7.89)	70.72 (7.25)	0.618
2021	n	67	126	
	% Correct, mean (SD)	60.81 (12.56)	64.10 (11.28)	0.094
2022	n	0	170	
	% Correct, mean (SD)	0	61.24 (13.34)	-

Table 4: Performance on VTE Exam Questions by VTE eCase Usage

Year	Characteristic	VTE eCase Users	VTE eCase Non-Users	p-value
2020	n	77	122	
	% Correct, mean (SD)	80.91 (14.29)	82.12 (13.29)	0.583
2021	n	61	132	
	% Correct, mean (SD)	73.88 (13.41)	68.15 (13.33)	0.005
2022	n	72	98	
	% Correct, mean (SD)	67.41 (14.40)	66.19 (17.33)	0.595

Table 5: Performance on Heart Failure Exam Questions by AHF eCase Usage

Year	Characteristic	AHF eCase Users	AHF eCase Non-Users	p-value
2020	n	77	122	
	AHF % Correct, mean (SD)	57.22 (12.58)	55.80 (13.54)	0.695
	CHF % Correct, mean (SD)	64.93 (12.31)	62.80 (11.70)	0.352
2021	n	61	132	
	AHF % Correct, mean (SD)	67.05 (14.48)	61.71 (14.51)	0.013
	CHF % Correct, mean (SD)	61.68 (12.47)	60.79 (11.91)	0.555
2022	n	72	98	
	AHF % Correct, mean (SD)	65.60 (19/79)	53.95 (19.77)	<0.001
	CHF % Correct, mean (SD)	52.60 (13.87)	46.60 (13.22)	0.002

AHF represents acute heart failure questions. CHF represents chronic heart failure questions.

CONCLUSIONS

- Use of an eCase is associated with improved student performance, as measured by exam and course scores
- Improvement in scores was most evident in the Fall 2022 semester, which may reflect continuous improvement in eCase design
- Association between use of content-specific eCases and performance on related exam questions varied
 - VTE and AHF eCases improved performance on related exam questions, though not consistently across all years
 - HTN eCase use did not appear to improve performance on related exam questions
- AHF eCase use associated with improved performance likely due in part to eCase closely matching style of exam questions
 - AHF eCase had cyclical component, providing immediate quantitative feedback (e.g. changes in blood pressure or cardiac index)
 - AHF eCase had the highest average number of uses per student and the highest number of possible outcomes
- Design of AHF eCase may have promoted better development of clinical decision-making skills that contributed to improved exam performance
- Further study is needed to elucidate what characteristics of an eCase provide the most impact in improving clinical reasoning and thus, exam and course performance

REFERENCES

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