



# Article Computer-Based Intelligent Solutions for the Diagnosis of Gastroesophageal Reflux Disease Phenotypes and Chicago Classification 3.0

Yunus Doğan <sup>1,</sup>\*<sup>D</sup> and Serhat Bor <sup>2</sup>

- <sup>1</sup> Department of Computer Engineering, Dokuz Eylül University, Izmir 35390, Türkiye
- <sup>2</sup> Department of Gastroenterology, Ege University Faculty of Medicine, Bornova, Izmir 35100, Türkiye; serhat.bor@ege.edu.tr
- \* Correspondence: yunus@cs.deu.edu.tr

**Abstract:** Gastroesophageal reflux disease (GERD) is a multidisciplinary disease; therefore, when treating GERD, a large amount of data needs to be monitored and managed. The aim of our study was to develop a novel automation and decision support system for GERD, primarily to automatically determine GERD and its Chicago Classification 3.0 (CC 3.0) phenotypes. However, phenotyping is prone to errors and is not a strategy widely known by physicians, yet it is very important in patient treatment. In our study, the GERD phenotype algorithm was tested on a dataset with 2052 patients and the CC 3.0 algorithm was tested on a dataset with 133 patients. Based on these two algorithms, a system was developed with an artificial intelligence model for distinguishing four phenotypes per patient. When a physician makes a wrong phenotyping decision, the system warns them and provides the correct phenotype. An accuracy of 100% was obtained for both GERD phenotyping and CC 3.0 in these tests. Finally, since the transition to using this developed system in 2017, the annual number of cured patients, around 400 before, has increased to 800. Automatic phenotyping provides convenience in patient care, diagnosis, and treatment management. Thus, the developed system can substantially improve the performance of physicians.

Keywords: artificial intelligence; healthcare systems; phenotyping

## 1. Introduction

Similar to studies in other departments of medicine, in studies of gastroesophageal reflux disease (GERD), data size is very important in obtaining accurate and reliable analysis results. However, recent studies described in the literature have been conducted with very little data. For example, 114 patients were evaluated in an ulcerative colitis study [1], 122 patients were analyzed in an inflammatory bowel disease study [2], and 400 patients were examined in a gastric cancer study [3]. A sample size of 400 patients is too low for accurate and reliable study of a disease as prevalent as gastric cancer. However, nowadays, large amounts of data can be stored within a regular-sized structure using a central database. Moreover, this type of information system can store patient data with distinctive characteristic features, such as different histories, sociodemographic data, etc. [4,5]. Thus, diverse data from various patient profiles have been used to determine the rules needed to create a decision support system (DSS) [6]. Nowadays, computerbased intelligent solutions are a necessity, and their use is widespread, including in the medical sector. Recent medical studies in the fields of data mining [7], artificial intelligence (AI) [8], machine learning, and deep learning have been conducted in relation to subjects such as medical image processing using radiological data [9] and early diagnosis of the deadliest diseases, such as heart disease, cancer, and diabetes [10,11]. In these studies, more than 85,000 patients have been analyzed to uncover more about these diseases, and these data have been used to develop information systems. The Ege University Medical



Citation: Doğan, Y.; Bor, S. Computer-Based Intelligent Solutions for the Diagnosis of Gastroesophageal Reflux Disease Phenotypes and Chicago Classification 3.0. *Healthcare* 2023, *11*, 1790. https://doi.org/10.3390/ healthcare11121790

Academic Editor: Daniele Giansanti

Received: 22 April 2023 Revised: 30 May 2023 Accepted: 14 June 2023 Published: 17 June 2023



**Copyright:** © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https:// creativecommons.org/licenses/by/ 4.0/). School, Division of Gastroenterology, Reflux Center, which has the largest number of patients in Turkiye, carried out a scientific research project (2015-TIP-070) on switching from a Microsoft-Access-based system, which was limited to analysis, to a web application (using ASP.NET technology) with a database (Microsoft SQL) with advanced reporting functions. This developed system is now the biggest database in Turkiye in terms of the number of patients, with data recorded from more than 8000 patients from 2017 to 2020. Although patient care and health recording were disrupted during the COVID-19 pandemic, information on a total of 12,000 patients was included by 2022. Many new algorithms can be created using data mining techniques with such a large patient series. In addition, intelligent software can be used to detect false-positive and false-negative rates in this comprehensive database of patient information. Furthermore, as the GERD phenotypes are not widely known among physicians, they are either not recognized or incorrectly identified. Thus, the created database and smart learning system was designed to help physicians in this sense. As a result, the system aims for GERD patients to be automatically classified into the phenotypes of erosive esophagitis, reflux hypersensitivity, functional heartburn, or nonerosive reflux disease (NERD). Additionally, it aims for patients to be automatically classified according to their manometry results using the Chicago Classification 3.0 (CC 3.0) rules and for the pH monitoring-impedance measurements of each patient to be automatically recorded after a routine examination such that the many parameters do not need to be remembered by health personnel. Therefore, this study can be used not only for scientific studies to facilitate data generation, as it is a very comprehensive database, but also for preventing errors that may arise during phenotyping. In addition, it is anticipated that the recognizability of 24 h pH impedance and/or high-resolution esophageal manometry and their classifications will increase.

## 2. Materials and Methods

This study was carried out as a pilot study to be used by the GERD study group of Ege University. In the study, as a first step, the data for 6234 patients archived between 2004 and 2017, including all of their treatment and examination data, were transferred to the developed system. Since 2017, all procedures have been performed using the developed system. Data for 2797 new patients were added to the system from 2017 to March 2020. Thus, in total, 9031 personal datasets, 5928 patient histories, 6760 endoscopy reports, 1100 classical or high-resolution manometry reports, 2462 radiology reports, 3390 consultations, 1974 reflux case discussion reports, 5609 all-drug dosage–process reports, and 4132 24 h intraesophageal impedance–pH monitoring or ambulatory capsule pH monitoring results have been included. In addition, the system has the capacity to hold data from 11 different questionnaires. These questionnaires include the Quality of Life in Reflux and Dyspepsia Questionnaire (QoLRAD) (with 12 and 25 questions), the GERD Question Forms (with 57, 66, and 81 questions), the Short Form-36 (SF-36), the Otolaryngology Form, the Otolaryngology Score, the Postop Question Form, the Reflux Disease Questionnaire (RDQ), and the Eckardt Score.

In this large and comprehensive database, patients with GERD and reflux motility problems were recorded, including details of their history, upper gastrointestinal endoscopy reports, questionnaire scores, classical or high-resolution esophageal manometry data, radiology reports, consultation reports, reflux council notes, medication doses and durations, and 24 h impedance–pH monitoring, such as their bravo capsule pH monitoring results. As a result, a decision support software package that allows examinations, questionnaires, and scores to be stored in the database, accessed upon request, decided on by the physician, and analyzed, has been created. As computer applications that make an automatic diagnosis are becoming widespread nowadays, the results of the multi-parameter pH monitoring, impedance, and symptom analysis obtained automatically over MMS (Medical Measurement Systems, The Netherlands) can be transferred to this database, as in Figure 1, and a diagnosis based on pH monitoring–impedance can be made (e.g., pH monitoring is pathologic, while impedance is normal; impedance is pathologic, while pH monitoring is

normal; both of them are pathologic; pathological acid reflux; impedance is upper bounded, while pH monitoring is pathologic; etc.). As a result, the data introduced by this software via copy–paste and text parsing methods are automatically separated into 48 parameters and, thus, can save users a lot of hard work.



**Figure 1.** The process of mining "pH monitoring—impedance—symptom analysis" reports, storing their parameters in a database, and publishing them for access on mobile communication devices, such as tablets, laptops, cell phones, etc.

Figure 2 shows an example of all parameters being automatically recorded into the system after the values are entered into the system as inputs. Thus, 48 parameters can be recorded in the database in less than a minute (manually, it would take approximately 5 min). Additionally, possible input errors are prevented.

						We	riler								
		old Metri Ölcüm Metri				Impedanc Ölcüm Metol:			Samotom	Applia Ölcim M	atob				
		per ween organi ween.				Impedans orçum Medni.			Sumeton	results	eun.				
	pH analysis results - Channel: pHi pH analysis results - Channel: pHi				<ul> <li>Impedence results</li> </ul>			<u>^</u>	Sympton results - Channel: pHI						
						Impedance event overview	edance event overview								
	Tarih : 02-10-2020	pH acid results	e Total			Total impedance events 54	22		Sympton:	Semptom	vete	Impedance and	alveis		
	Upright Supine Total Duration 5:00 11:15			Impedance events during meal 28 Swallows 2				Acid Reflux Acid Reflux weakly acid weakly alkaline							
	Açıklama:	Duration 44.8	55.2 100.0	• X	% Unknown directions 0				Total	Complete time	(41 + 4 4)	(#1 - 1 - 0 - )	(1.0. 7	a) (7.a.,	
		Total reflux time (pH	(a 4.8) 37.2 (a 4.8) 6.8	45.9 53.1	820	Refluxes 54			5	symptom time	(pH < 4.9)	(pH < 4.0 )	(4.9 - /	(7.8 <	~
		Mr of reflux periods	43 30	73	*	Reflux table		*	1	1/14:39:12			•		-
					► 1	<		× //	2	1/15:43:18					
	Telefore Westernin - Ketatas Tie	A statement Kat	and and a												
	Takima tontemi : Kateter Tip	Araştırma Kat	teterien :												
	[005 = 15 dH (Kbb) •] (6 Hp, 1 pH	♥   [108	•												
	pH														
	Distal	~						Analiz Ver	rileri						
				İsim			Ölçüm								
				NUMPER OF RESIL	IN REDUCIDE - TOTAL			Tip:				Tiple Semptom Ana	skzi (Symptom)	~	
	İsim	Ölçüm		NUMBER OF RELED				Basma m	sixtari 3 der	n tazia mir:	_				
	pHc4 % - TOTAL		1	NUMBER OF REFLU	IX PERIODS - UPRIGHT			Sc			-				
				NUMBER OF REFLU	IX PERIODS - SUPINE			559.2			-				
	pHK4 % - UPRGH1			NUMBER OF LONG	PERIODS>S MIN - TOTAL			SAP:			_				
	pHK4 % - SUPINE		]	AND FOLD OF LONG	07010001-5 1001 10001017			E							
	pH<4 MIN - TOTAL		1	NUMBER OF LONG	PERCOSPS MIN - OPROMI										
	AND AND UPDICIT		1	NUMBER OF LONG	PERIODS>5 MIN - SUPINE										
	prise mine - OP Kight			LONGEST REFLUX N	AIN - TOTAL										
	pH<4 MIN - SUPINE		J	LONGOT OCCUPUS	IN UNRUT										
	DeMeester SCORE(P)			CONFRED TRETEOR IN	init - or knarm										
			-	LONGEST REFLUX N	AIN - SUPINE										
				PPI (yoksa 0, varsa	dozuna göre 1 ya da 2 girini	z)									
- A 🖸 🛛	- Terrende an														
	Impedans														
	İsim Ölçüm														
	Befluxes														
	Pichokes														
	Acid														
	Weekly Acid														
	New Artic	_													
	Nonacio														
	Mixed														
	Super Impose														
							+								
							Veriler								
	Tarih :			02-10-2020											
	Aciklama :	Ardiana Variationa													
	Açidime :														
	Takima Viotemi I Katates	Tiel Arethree	- Katatarlari -												
	Takılma Yöntemi : Kateter (UOS + 15 cm (KBB) ¥ (6 imp.)	Tipi : Araştırma	a Kateterleri :												
	Takılma Yöntemi : Kateter UOS + 15 cm (KBB) V 6 imp. 1	Tipi : Araştırma pHijntraögol 🗸 Yok	a Kateterleri : V									]			
	Takılma Yöntemi : Kateter (UOS + 15 cm (KB8) ♥) (6 imp.) pH	Tipi : Araştırma tehintraözot V (Yok	a Kateterleri : V									)			
	Takima Yöntemi : Katetei UOS + 15 cm (KBB) V 6 mp ; pH Proximal	Tipi : Araştırma pHijnhaözot V (Yok	a Kateterleri :									Yeni Semptom Ar	nalizi Ekke		
	Takolma Yontemi : Katetes (UOS = 15 cm (KBB) ♥) (6 mg.) pH [Proximal	Tipi : Araştırmı (pH)intraöcol V) (Yok	a Kateterleri :		İsim		Ölşüm		Anali	iz Verileri		Yeni Serrptorn Ar	valizi Ekie		
	Takifma Yöntemi : Katetei (UOS = 15 cm (KBB) ♥) (6 imp.) pH (Proximal	Tipi : Araphrma pHimhabeol V (Yok	a Kateterleri :		Isim NUMBER OF REFLUX	: PERIODS - SUPINE	Ölçüm [30		Anali	iz Verileri		Yeni Semptom Ar	nalizi Ekie	(Sumiran) v	
	Takima Yöntemi : Katetet UOS = 15 cm (KBE) V (6 imp.) pH (Proximal	Tipi: Araştırma rpHjintralazət v Yok	ölçüm		NUMBER OF REFLUX	PRIJODS - SUPINE	Ölçüm (30		Anali Tip: Basis	iz Verileri na militari 3'den	aria m?	Yeni Semptom Ar	valizi Ekłe emptom Analiz	(Symptom) 🗸	
	Takima Yöntemi : Kateter [UOS = 15 cm (KBB) v] (5 imp.) pH [Proximal [isim DH<4 MIN - UPRIGHT	Tipi : Araşhırmı pHjinfratzot V Yok	Ölçüm 37.2		Isim NUMBER OF REFLUX NUMBER OF REFLUX	I PERIODS - SUPINE PERIODS - TOTAL	δίμῦm [30 [73		Anali Tip: Basin	iz Verileri na miktarı 3'den	iazia mi?:	Yeni Semptom Ar	valizi Ekie emptom Analiz	(Symptom) 🗸	
	Takima Yöntemi : Kateter (UOS = 15 cm (KB5) v) (8 mp.) ptt [Proximal [sim pt+cd MIN - UPRIGHT	Tipi: Araştırmı IpHijnfradzol V (Yok	Ölçüm 37.2		Isim NUMBER OF REFLUX NUMBER OF REFLUX NUMBER OF LONG F	I PENIODS - SUPINE PERIODS - TOTAL PERIODS - TOTAL	Ölşüm 30 73 0		Anali Tip: Basin St	iz Verileri na miktarı 3'den 44.4	azia mi?:	Yeni Semptom Ar	valizi Ekie emptom Analiz	(Symptom) 💌	
	Takkima Yöntemi : Kateter (UCS = 15 cm (KBB) V) (5 mp.) pH (Provimal Lisim pH<4 MIN - UPRIGHT pH<4 MIN - SUPINE	Tipi : Araştırma (sti)minacosi v ) (Yok	a Kateterleri : V Ölçüm 37.2 45.9		Isim NUMBER OF REFLUX NUMBER OF REFLUX NUMBER OF LONG F	I PERIODS - SUPINE I PERIODS - TOTAL ERIODS-S MIN - UPRIGHT ERIODS-S MIN - SUPINE	0t;0m 30 173 0 2		Anali Tip: Basn SC	iz Verileri ma miktarı 3'den 41.4 14.8 14.9	'azla mi?:	Yeni Semptom Ar	nalizi Ekie emptom Analiz	(Symptom) 💙	
	Takima Yöntemi : Kateter (UCS + 15 em (KBS) ▼) (6 mg.) pH [Proximal [Isim pH<4 MIN - UPRIGHT pH<4 MIN - SUPINE pH<4 MIN - TOTAL	Tipi : Araştırmı teti interest vi (Yok	a Kateterleri : V Ölçüm 37.2 45.9 53.1		kim NUMBER OF REFLUX NUMBER OF REFLUX NUMBER OF LONG F NUMBER OF LONG F	I PERIODS - SUPINE PERIODS - TOTAL PERIODS-S MIN - UPRIGHT PERIODS-S MIN - SUPINE	Ölçöm 30 73 0 2		Anali Tip: Basn SC SSI: SAP:	iz Verileri ma miktarı 3'den 44.4 14.8 100	azia mi?:	Yeni Semptom Ar	nalizi Ekke emptom Analiz	(Symptom) ¥	
	Taklma Yöntemi:     Katetei       UOS:=15 cm X865 v     (8 mp.)       pH     (Posimal       Isim     pH       pH     4 MIN - UPRIGHT       pH<4 MIN - UPRIGHT     pH<4 MIN - UTIAL       pH<4 MIN - TOTAL     pH<4 MIN - TOTAL	Tipl: Araştırmı  pHinhacool♥] (Yok	a Kateterleri : V Ölçüm 37.2 45.9 63.1 6.8		kim NUMBER OF REFLUX NUMBER OF REFLUX NUMBER OF LONG F NUMBER OF LONG F	PPRIODS - SUPINE PRIODS - TOTAL PRIODS - SINN - UPRIGHT ERIODS - SINN - SUPINE PRIODS - SINN - TOTAL	0kjim 30 73 0 2 2		Anali Tip: Basn St SS: SAP: P:	iz Verileri ma miktarı 3'den 44.4 14.8 100 0	'azla mi?:	Yesi Semptom Ar	nalizi Ekie emptore Analiz	(Symptom) ♥	
	Takkman Vinntemi : Katete UOS = 15 cm r886) ♥ (6 mg ; pH Prommal DH44 MIN - UPRIGHT pH44 MIN - UPRIGHT pH44 MIN - SUPRIGHT pH44 SI = UPRIGHT	Tipl: Araştırmı tpHjnhačost ♥   Yok	ölçüm           37.2           45.9           53.1           6.8		Isim NUMBER OF REFLUX NUMBER OF LONG F NUMBER OF LONG F NUMBER OF LONG F LONGEST REFLUX M	I PERIODS - SUPINE I PERIODS - TOTAL ERIODS-S MIN - UPRIGHT ERIODS-S MIN - SUPINE 'ERIODS-S MIN - TOTAL N - UPRIGHT	0içûm 19 73 0 2 2 49		Anali Tip: Basin 30 SSI: SA0: P:	iz Verileri ma miktarı 3'den 44.4 14.8 100 0	'azla mi?:	Veni Serrptom Ar	nalizi Ekie emptom Analiz	(Symptom) 🗸	
	Takima Yöntemi:         Kateter           UOS: 15 cm X285 v)         (8 mp.)           pH         [Posimal           Isim         pH           pH         MIN - UPRIGHT           pH         AIN - UPRIGHT           pH         MIN - UPRIGHT           pH         MIN - UPRIGHT           pH         MIN - UPRIGHT           pH         MIN - SUPINE           pH         SUPINE           pH         SUPINE	Tipl : Araştırmı  pHjirhacool ♥] (Yok	a Kateterleri :		isim NUMBER OF REFLUX NUMBER OF REFLUX NUMBER OF LONG F NUMBER OF LONG F LONGEST REFLUX M LONGEST REFLUX M	PERIODS - SUPINE PERIODS - TOTAL ERIODS - MIN - UPRIGHT ERIODS - MIN - SUPINE ERIODS - MIN - TOTAL N - UPRIGHT N - SUPINE	Ölçilm           10           173           0           2           49           6		Anali Tip: Basn St Sk Sk P:	iz Verileri ma miktari 3'den 14.4 100 0	iazia mi?:	Yeni Sempton Ar	valizi Ekke emptom Analiz	(Symptom) 💙	
	Tablema Kintenii         Kaketee           (G65 - 15 em 2686) ➡         (é mg.)           pH         Provinsii           Isim         pH           pH         Provinsii           pH         pH           pH         <	Tipi : Araştırmı geli prinacost v Vok	6.6 6.8		kim NUMBER OF REFLUX NUMBER OF LONG F NUMBER OF LONG F NUMBER OF LONG F LONGEST REFLUX M LONGEST REFLUX M	LPERIODS - SUPINE PERIODS - TOTAL ERIODS-S MIN - UPRIGHT ERIODS-S MIN - SUPINE ERIODS-S MIN - TOTAL N - JURIGHT IN - SUPINE	Otóm 30 73 0 2 2 40 6.0		Anali Tip: Basn St SS: SA0: P:	iz Verileri ma miktarı 3'den 44.4 14.8 100 0	iazia mi?:	Veni Serrptom Ar	nalizi Ekke erriptom Analiz	(Symptom) 💌	
	Tailing Statem         Katele           UDS = 15 m.1080 w)         (4 mg.)           pH         Permai           Permai         pH4 MIN = UPRIGHT           pH4 MIN = UPRIGHT         pH4 MIN = UPRIGHT	Tipi : Araştırmı  stijnfrasost V (Yok	a Kateterleri :		Isim NUMBER OF REFLOX NUMBER OF CLONG NUMBER OF LONG F NUMBER OF LONG F LONGEST REFLOX M LONGEST REFLOX M	PERIODS - SUPINE PERIODS - TOTAL ERIODS - MIN - UPRIGHT ERIODS - MIN - SUPINE ERIODS - MIN - TOTAL N - UPRIGHT N - SUPINE N - SUPINE	δίζθη 120 73 2 2 48 8.8 6.8 6.8 6.8		Anali Tip: Basin St SSI: SA0: P:	iz Verileri ma miktarı 3'den 44.4 14.8 100 0	iazia mi?:	Yesi Sempton Ar	valizi Ekke	(Symptom) ♥	
	Takima Shotmin : Katele (1905 : 15 m.1266) ▼ ( 谷田安.) pH [Perama PH-4 MIN - SUPINE pH-4 MIN - SUPINE pH-4 MIN - SUPINE pH-4 MIN - SUPINE pH-4 Si - SUPINE pH-4 Si - SUPINE pH-4 Si - SUPINE pH-4 Si - SUPINE pH-4 Si - SUPINE	Tipi : Araghme ghintasolv ) Yok	a Kateterleri :		Isim NUMBER OF REFLUX NUMBER OF REFLUX NUMBER OF LONG F NUMBER OF LONG F NUMBER OF LONG S NUMBER OF LONG LONGEST REFLUX M LONGEST REFLUX M De Meeter SCORE[IP	PERIODS - SUPINE PERIODS - TOTAL ERIODS - SIMN - UPRIGHT ERIODS - SIMN - TOTAL IN - SUPINE IN - SUPINE N - TOTAL )	060m 39 0 2 2 2 4.9 6.5 8.8 2.75		Anali Tip: Basn St: SAC: P:	iz Verileri ma miktarı 3'den 14.8 100 0	azia mi?:	Veni Serrptom Ar	valici Ekie emptom Analic	(§)mpton) ♥	
	Takima Silatemi : Katete (UDS = 15 an (260 x) ( 4 mg ) pt Permai katete price MIN - UPRIGHT price MIN - UPRIGHT price MIN - 1070A, price 3 - UPRIGHT price 3 - UPRIGHT price 3 - TOTA, NUMBER OF REFULX PERIODS	Tipi : Araştırma (str)inteatori Vitek	öltçüm           37.2           45.9           63.1           6.8           6.8           45		Islam NUMBER OF REFLUX NUMBER OF LONG NUMBER OF LONG NUMBER OF LONG LONGEST REFLUX M LONGEST REFLUX NUMBER OF LONG FLOWERST SCREUX PH (tyteks Config	PERIODS - SUPINE PERIODS - TOTAL ERIODS-35 MIN - UPRIGHT ERIODS-35 MIN - UPRIGHT ERIODS-35 MIN - TOTAL N - SUPINE N - SUPINE N - TOTAL ) coma giore 1 ya da 2 giriniti)	διράm 10 17 2 2 2 49 60 60 60 2275 60 60 60 60		Anali Tip: Basi Sc SSc SAC: P:	iz Verilleri na miktarı 3'den 143 100 0	iazia m:?:	Yeel Sempton Ar	nalizi Ekke emptom Analiz	(Symptom) V	
	Takima Stotemi : Katele (1905 : 15 m.1866 v) ( 8 mg.) pt [Perama pt+4 Min - L906(pt) pt+4 Min - 1906(pt) pt+4 Min - 1906(pt) pt+4 Si - 500 Min - 1008(pt) pt+4 0 Mi	Tipi : Araghme gatyfraxoot Via	a Kateterlerl :		Islam NUMBER OF REFLUX NUMBER OF LONG NUMBER OF LONG NUMBER OF LONG LONGEST REFLUX M LONGEST REFLUX M LONGEST REFLUX M DEVELOSE SCORE PPI (toksa 0, varia d	I PRINCIOS - SUPINE PRINCIOS - SUPINE RENCIOS-S MINI - UPRIGINT RENCIOS-S MINI - TOTAL NI - SUPINE NI - SUPINE NI - TOTAL ) cocura give 1 ya da 2 granaj	00,0m 12 13 14 14 14 14 15 15 15 15 15 15 15 15 15 15 15 15 15		Anali Tip: Basn S: SS: SAP: P:	iz Verileri ma miktarı 3'den 143 100 0	azla mi?:	Yeni Serrpton Ar	valici Ekke	(Symptom) V	
	Takine         Katche           (1) (05:15:00:00) い。(4:00)、         (4:00)、           (4)         (7)           (4)         (7)           (5)         (7)           (5)         (7)           (6)         (7)           (7)         (7)	Tişki: Araşburnu gətiyinfatadot V (Yat	a Kateterlerl : v		Islam NUMBER OF REFLUD NUMBER OF LINGE NUMBER OF LINGE NUMBER OF LINGE LONGEST REFLUX LONGEST REFLUX Deliverster SCORE(IP PPI (volca 0, varia d	PERIODS - SUPINE PRENDS - TOTAL PRENDS - MIN - BERNIT PRENDS - MIN - URRHIT PRENDS - MIN - SUPINE PRENDS - MIN - SUPINE PRENDS - MIN - SUPINE PRENDS - SUPINE - SUPIN	045m 10 17 2 2 2 49 65 65 65 22 7 9 0 0		Anali Basn St Sst St P:	iz Verileri na miktarı 3'den 44.4 14.8 100 0	azia mi?:	Vesi Serrpton Ar	valici Ekke emptom Analic milci Ekke	(Symptom) V	
	Takima Nidemi         Katelet           (1907 13 an 286) x)         (4 mp.)           pH         Provid           (bins)         (bins)           pH4         Provid           (bins)         (bins)           pH4         Provid           (bins)         (bins)           pH4         Provid           (bins)         (bins)           pH4         (bins)           (bins)         (bins)           (bins)         (bins)           (bins)         (bins)           (bins)         (bins)	Tipi : Araghme gatymaxou Via V	a Kateterleri :		Islam NUMBER OF REFLUX NUMBER OF LONG F NUMBER OF LONG F NUMBER OF LONG LONGEST REFLUX M LONGEST REFLUX M LONGEST REFLUX M DEVELOSE VERSION PPI (yoka 0, vana d Islam	respos-suprae Seaso-survey unsert seaso-survey unsert seaso-survey unsert seaso-survey unsert n - unsert n - unsert n - rotal t t t t t t t t t t t t t t t t t t	00,0m 30 73 0 2 2 40 6.5 6.5 6.5 6.5 6.5 0 75 0 0 0 0 0 0 0 0 0 0 0 0 0		Anali Tip: Basn St: SAP: P: Anali	iz Verileri ma miktarı 3'den 44.4 14.8 10 0 0	iazia mi?:	Veli Semptom Ar	valizi Elde emptom Analizi	(§)mplom) ♥)	
	Takimo Nistenii         Catelet           (1007: 135 m286) x)         (4 mp.)           PF         Proteinii           Intern prod Mini - UPBIGHT         prod Mini - UPBIGHT           prod Mini - 1003A, prod Mini - 1003A, prod Mini - 1003A,         prod Mini - 1003A, prod Mini - 1003A,           Mundez of REFLIX PERIODS         Comm	Tişki: Araşburne çatiyinfratkol V (Vat	■ Katelerlerl :		Isim NUMBER OF REFLUX NUMBER OF CLONG I NUMBER OF LONG I NUMBER OF LONG I LONGEST REFLUX DeMester SCORE[P PP] (volsa 0, varia d NUMBER OF REFLUX NUMBER OF REFLUX	PRINCOS - SUPINI     PRINCOS - SUPINI     PRINCOS - TOTAL     PRINCOS - TOTAL     PRINCOS - SUM- SUPINI     PRINCOS - SUM-     SUPINI     N - TOTAL     Socura gire 1 ya 6 2 girni)     PRINCOS - SUPINI	Йсан 19 19 2 2 49 43 43 43 43 44 43 44 44 44 44 44 44 44		Anali Tip: Bash St St St St St St St St St Tip: P:	iz Verileri Ma miktarı 3'den 44.4 14.8 100 0 0	azia mi?:	Ves Sergton Ar	valici Ekte	(Symptom) V	
	Табалта (около) к лание. 1005-11 бол 2008 v ( блар.) РИ Генета Бана	Tişi: Araşlama gelirinizator V İ'ta V UPRIGHT	a Kateterleri :		Islam NUMBER OF REFLUX NUMBER OF REFLUX NUMBER OF LONG NUMBER OF LONG CONGST REFLUX NUMBER OF REFLUX NUMBER OF REFLUX NUMBER OF REFLUX NUMBER OF REFLUX NUMBER OF REFLUX	IPRIODS - SUPINE IPRIODS - TOTAL EREDOSS TOTAL EREDOSS INN - LURISHIT EREDOSS INN - TOTAL IN - SUPINE IN - SUPINE Social agine 1 ya da 2 graniti - PRIODS - SUPINE - REDOST - SUPINE	Ölçöm           10           10           12           2           2           80           83           27.5           9           0           10           10           11           12           13           14           15           16           17           10           10           10           10           10           11           12           13           14           15           15           16           17           18           19           10           10           10           10           10           10           10           10           10           10           10           10           10           10           10           10           10		Anali Tip: SS: SAP: P: Anali Tip:	iz Verileri ma miktarı 3'den 44.4 14.3 10 0 0 iz Verileri na miktarı 3'den	iazia mi?:	Vex Sempton Ar	valici EMe emptore Analizi valici EMe emptore Analizi	(Symptom) ♥ (Symptom) ♥	
	Tablass Solveni L. Acter USDST 15 and 25 V (Jam). PF (Froma prick Min - UPRIORT prick Min - UPRIORT prick Min - UPRIORT prick Min - UPRIORT prick N - UPRIORT prick N - UPRIORT prick N - UPRIORT Data	Tişi: Araşlama patrimanol vi Yatı	■ Kateterlerl :		Islam NUMBER OF REFLUX NUMBER OF EXCLUSION NUMBER OF LONG 7 NUMBER OF LONG 7 NUMBER OF LONG 7 LONGEST REFLUX DEVELOPMENT REFLUX DEVELOPMENT REFLUX PPI (toksa 0, vana d NUMBER OF REFLUX NUMBER OF REFLUX	PERIODS - SUPPAR PERIODS - TOTAL REBOODS MIN - UPBORT REBOODS MIN - TOTAL REBOODS - MIN - TOTAL ) concurre gene 1 ye do 2 gionol PERIODS - SUPPAR PERIODS - TOTAL	Οιρίαπ           30           173           0           2           40           6.8           2.473           0           0           16		Anali Tip: Basin Sc SAC: P: Anali Tip: Basin	iz Verileri ma miktarı 3'den 44.4 100 0 0 iz Verileri iz Verileri Maturi 3'den	iazia mi?:	Yest Sergton Ar	natzi Ekke emptom Analiz natizi Ekke emptom Analiz	(Symptom) V (Symptom) V	
	Tablem Street         Active           PH         F           (Format         F           prime         F	Tişki : Araşburna gətirinfastor V (Yat	Statesrieri           V           37.2           45.9           63.1           68           68           63           63           53           64           54           57.2		Islam NUMBER OF REFLUX NUMBER OF IONG I NUMBER OF LONG I NUMBER OF LONG I NUMBER OF IONG OF IONG I PERSON Deliverator STRENUX NUMBER OF REFLUX NUMBER OF REFLUX NUMBER OF REFLUX	REBOOS - SUPPLE     REBOOS - SUPPLE     REBOOS - MUN - UPROHT     REBOOS - MUN - TOTAL     N SUPPLE     REBOOS - MUN - TOTAL     N SUPPLE     N TOTAL     Supple     REBOOS - SUPPLE     REBOOS - SUPPLE     REBOOS - SUPPLE     REBOOS - SUPPLE     REBOOS - SUPPLE	Ocion           39           73           0           2           43           68           88           9           0           0           0           0           0           0           0           11		Anali Tip: Basn St: SS: SA: P: Anali Tip: Basn St:	is Verileri na miktarı 3'den 144 146 0 0 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	iazia mi?:	Veil Sempton Ar	valizi EMe emptom Analiz valizi EMe emptom Analiz	(Symptom) ♥ (Symptom) ♥	
	Tabless Stockesi L. Addet         Addet           PH         F           Image: Stockesi L. Addet         Stockesi L. Addet           pmd. Min. Vol900; F         Stockesi L. Addet           pmd. Min. Vol900; F         pmd. Min. Vol900; F	UPRIGHT	Stateterferl :           V           37.2           45.9           10.1           6.8           6.8           6.8           6.8           6.8           6.5           6.6           6.7           5.7		Isim NUMBER OF REFLUX NUMBER OF ISING NUMBER OF ISING NUMBER OF ISING ISING ST REFLUX ORGEST REFLUX DeMeeters FREILIN PM (Voka 0, varia d NUMBER OF REFLUX NUMBER OF REFLUX NUMBER OF REFLUX NUMBER OF ISING	PRINDOS - SUPPINE     PRINDOS - TOTAL     PRINDOS - TOTAL     REINDOS - NUN- LURBART     REINDOS - NUN- TOTAL     N - SUPINE     N - SUPINE     PRINDOS - SUPINE     PRINDOS - SUPPINE     PRINDOS	Ölçön           30           73           0           2           2           30           6,9           6,9           6,8           2,75           0           0           0           0           0           0           0           0           0           0           0           0           0		Anali Tip: Basin St: St: St: P: Anali P: P: Anali St: St: St: St: St:	iz Verileri ma miktarı 3'den 148 100 0 iz Verileri ma miktarı 3'den 44 148	iazia mi?:	Yesi Sergion Ar	valizi Elde emptom Analiz valizi Elde emptom Analiz	(Symptom) ♥)	
	Tabless Storesii         Acatego View           PF         (Franzi           PF	UpRIGHT	Attesterleri:           V           37.2           45.9           63.1           68           68           68           68           68           69           43.1           100           45.1           100           1100		Islam NUMBER OF REFLOX NUMBER OF CIDED NUMBER OF CIDED NUMBER OF CIDES CONSIST REFLOX NUMBER OF CIDES Deletesite Sectors PH (betas 0, varial Mumber OF REFLOX NUMBER OF CIDES NUMBER OF CIDES NUMBER OF CIDES	PRIRODS - SUPPAR PRIRODS - TOTAL PRIRODS - NON-UPRIGHT PRIODS - NN - UPRIGHT PRIRODS - NON- N - SUPPR - N - SUPPR - N - TOTAL - PRIRODS - SUPPR - PRIRODS -	διρίου           13           13           13           2           2           43           63           64           63           64           65           66           67           68           69           61           62           63           64           65           66           67           68           69		Anali Tip: Ss: Ss: Ss: ss: P: Anali Ss: Ss: Ss: Ss: Ss: Ss: Ss: Ss: Ss: Ss:	is Verileri na miktarı 3'den 144 148 100 0 0 iz Verileri na miktarı 3'den 444 143 100 0 0	iazia mi?:	Vesi Sempton Ar	valizi Elde emptom Analiz valizi Elde emptom Analiz	(Symptom) V	
	كَلَوْنَا اللَّهِ اللَّهُ اللَّٰ اللَّٰ اللَّالِيلَّةُ اللَّٰ اللَّالِيلَّةُ اللَّٰ اللَّٰ اللَّالِيلَّ اللَّٰ اللَّالِيلَّةُ اللَّالَ اللَّالَ اللَّالَ اللَّالَ اللَّالِيلَّةُ اللَّٰ اللَّالَ اللَّٰ اللَّالَ اللَّالَةُ اللَّالَ اللَّالَ اللَّالَ اللَّالَ اللَّالَ اللَّالَةُ اللَّالَةُ اللَّالَةُ اللَّالَةُ اللَّالَةُ اللَّالَةُ اللَّالَةُ اللَّ	Tipi Anglom physicated v ) Via v)	Stateterferl :           V           37.2           45.9           10.1           6.8           6.8           6.8           6.3           6.5           10.1           5.7           5.7           675           122.3           99.9		Islam NUMBER OF REFLUX NUMBER OF ISLAG NUMBER OF ISLAG NUMBER OF ISLAG NUMBER OF ISLAG NUMBER OF ISLAG NUMBER OF ISLAG DeMesser Stocker PPI (vakaa, varaa) NUMBER OF REFLUX NUMBER OF ISLAG NU	PRIBOD - SUPINE           PRIBOD - SUPINE           PRIBOD - TOTAL           PRIBOD - SUPINE	Öçüm           30           13           2           40           2.2           40           2.2           40           2.33           0           0           0           10           11           0		Analii Tipi: Basma St St St St St St St St St St St St St	iz Verileri ma miktarı 3'den 143 100 0 0 10 10 143 148 148 100 0 0	azia mi?:	Vesi Sempton Ar	valici Elde emptom Analiz valici Elde emptom Analiz	(Symptom) ♥)	
	تلماست (Store) ، کرداند (Store)	Tel : Anglern phireated V (Ya V) Va	Kateterlerl :           V           64;00m           37:2           65:9           63:1           68           68           69           63           64           63           64           63           64           63           64           65           67           68           69           61           62           63           64           64           69           1222.3           99           1122.3           109		Islem NUMBER OF REFLUD NUMBER OF REFLUD NUMBER OF REFLUD NUMBER OF LONGE NUMBER OF LONGE NUMBER OF LONGE NUMBER OF LONGE NUMBER OF LONGE NUMBER OF REFLUD NUMBER OF REFLUD NUMBER OF CONGE NUMBER OF CONGE NUMBER OF CONGE NUMBER OF CONGE NUMBER OF LONGE NUM	PRILODS - SUPPLIE PRILODS - TOTAL ERIDDOS - TOTAL ERIDDOS - NUN- LURBERT ERIDDOS - NUN- TOTAL I - SUPPLIE PRILODS - TOTAL ERIDDOS - SUPPLIE ERIDDOS - SUPPLIE ERIDDOS - TOTAL ERIDDOS - SUPPLIE ERIDDOS - TOTAL ERIDDOS - TOTAL ERIDDOS - NUN- LURBERT ERIDDOS - NUN- NUN- ERIDDOS - NUN- NUN-	Opport           30           30           30           30           40           2           40           60           24           60           25           60           2475           0           10           11           60           11		Anali Tip: Basin SAP: P: Anali SAP: Basin SL: Basin SL: SAP: Basin SL: SAP: P:	iz Verileri na miktarı 3'dan 14.8 100 0 iz Verileri iz Verileri 44.4 14.5 0 0	azia mi?:	Vesi Sempton Ar	valici EMe emption Analici valici EMe emption Analici	(Symptom) V	
	Balans Montenie         Anderse           BH         (Framula           Image: State of the st	Таўі: Андатон Длянянач ( ( ка )  циянонт 	Batteriferi:         V           0/cilam         37.2           45.9         10.1           6.8         6.8           6.8         6.8           6.9         10.1           10.1         10.1           10.1         10.1           10.1         10.1           10.1         10.1           10.1         10.1           10.1         10.1           10.2         10.1		Lon         Lon           WALNESS OF FILLURE         WALNESS OF FILLURE           WALNESS OF LONG         WALNESS OF LONG           W	PRIDOS - SUPINE PRIDOS - SUPINE PRIDOS - TOTAL PRIDOS - SUNNE PRIDOS - SUNNE PRIDOS - SUNNE PRIDOS - SUPINE PRIDOS - S	Ölçön           19           19           10           10           2           43           43           43           43           10           10           11           11           11           11           11           11           11		Anali Top: Bosn SS: SAR: P: Anali Tip: Bosn SL SSR: SR: SR: SR: SR: SR:	iz Verileri na miktari 3'den 143 100 0 0 0 10 100 10 100 0 0	iazia m:?:	Veti Sempton Ar	natzi Ekte emptom Analiz natzi Ekte	(Symplom) V (Symplom) V	
	지수님께 (Kinesi) Katel (Social Standard) Katel (Social Standard) (Social Standard) (	Трі: Аорати (за. (за. ) • • • • • • • • • • • • • • • • • • •	Atteterferl :           V           64:00m           37:2           45:9           63:1           68           63           64           63           63           63           63           63           63           63           63           63           63           64           63           64           64           65           62           63           64           64           65           66           67           68           69           100           100		Bain         Bain           NUMMER OF REDUCTIONS         NUMMER OF REDUCTIONS           NUMMER OF LODGE         NUMMER OF LODGE           NUMMER OF LODGE         NUMMER OF LODGE           OFMERT STRUCK         NUMMER OF LODGE           OFMERT STRUCK         NUMMER OF LODGE           Privesses         NUMMER OF LODGE           NUMMER OF LODGE         NUMER           NUMER	PPRIODS - SUPPLE     PPRIODS - TOTAL     PPRIODS - TOTAL     PPRIODS - TOTAL     PPRIODS - TOTAL     N - UNRER[     N - UNRER[     PRIODS - TOTAL     PPRIODS - TOTAL     PPRIODS - TOTAL     PPRIODS - TOTAL     N - UNRER[     N	Ölçön           10           10           12           2           40           60           2475           60           2479           60           121           125           131           141           141           141		Anali Tip: Basn Sc Sc Sc Sc Basn Basn Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc Sc	iz Verileri na miktarı 3'dan 148 100 0 12 148 148 148 148 148 148 148 0 0	azia mi?:	Veni Serryton Ar	valici Ekke	(Symptom) ♥)	
So So 1	Tabless Storessi         Academic Storessi         Academic Storessi           PF         (freename         (freename           PM         (freename	UPBOHT	Stateterferi :           V           64çilium           57.2           63           63           68           68           63           63           63           63           63           63           64           102           1222.3           99           100           109           109		Ean No.Med O FRUID No.Med O FRUID No.Med O Labor No.Med O Labor O Martine State Destroy and State Destroy and State Destroy and State Destroy and State No.Med O Fruid No.Med	PRINDOS - SUPPAR PRINDOS - TOTAL PRINDOS - TOTAL PRINDOS - TOTAL PRINDOS - SUPPAR - NORMET - NORMET - PRINDOS - TOTAL PRINDOS - TOTAL - NORMET - NORMET - NOTAL - NOTAL	Ölçöm           30           73           0           2           4.0           6.8           6.8           2           2           2           30           0           0           0           10           11           13           68           61		Anali Basn St. Sa: P. Anali Basn St. Sta: P.	iz Verileri a verileri 14.8 10.0 0 14.8 10.0 0 14.8 14.8 10.0 0 14.8 14	iazia m:?:	Ves Sempton Ar	valizi Ekte emptioni Analiz valizi Ekte	(Symptom) V (Symptom) V	
S S 1	كَلَوْنَ اللَّهِ اللَّهُ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّ	Taji: Angeneral (ra) (ra) (ra) (ra) (ra) (ra) (ra) (ra)	Stateterleri :         V           37.2         65.9           63.1         68.8           64.0         68.8           65.0         68.8           67.0         69.9           102.0         102.9           102.0         102.9           102.0         102.9           102.0         102.9           100.0         109.9           100.0         109.9           105.0         105.9		Non         Security 20           SULVERED OF REFLUCTOR FOR CONTROL         SULVERED OF DEFENDING           SULVERED OF DEFENDING         SULVERED OF DEFENDING           SULVERED OF DEFENDING         SULVERED OF DEFENDING           CONSECTION FOR CONTROL OF REFLUCTOR         SULVERED OF DEFENDING           SULVERED OF REFLUCTOR         SULVERED OF REFLUCTOR           SULVERED OF REFLUCTOR         SULVERED OF REFLUCTOR           SULVERED OF REFLUCTOR         SULVERED OF REFLUCTOR           SULVERED OF REFLUCTOR         SULVERED OF DEFENDING           SULVERED OF REFLUCTOR         SULVERED OF REFLUCTOR		Öçüm           19           19           2           43           45           45           46           57           6           9           10           11           6           11           6           11           6           12           13           141           142           143           143		Anali Tip: Basin SSC SAP: P. Manili Basin SIC SAP: P.	iz Verilleri a verileri iz Verileri iz Verileri ma miktarı 3'dan ma miktarı 3'dan ma miktarı 3'dan ma miktarı 3'dan	iazia mi?:	Ven Sempton Ar	nalizi Ekke emptom Analiz nalizi Ekke emptom Analiz	(Symptom) V (Symptom) V	
No 5	지수님께 정도 전체 (1998년~1997) 전 (1997년~1997	UPROFT	A Katekerkeri : V 37.2 43.1 6.6 6.6 6.6 43 05,000 1222,3 19.9 1222,3 19.9 10.0 1222,3 10.0 1222,3 10.0 1222,3 10.0 122,3 10.0 122,3 10.0 122,3 10.0 12,5 10.0 12,5 10.0 12,5 10.0		Eam         Nummet of P REPUB           Nummet of P Repub         Nummet of P Repub           Overlaget T Repub         Nummet of P Repub           Nummet of P Repub         Nummet of P Repub           Nummet of P Republic P Repub	PERIODS - SUPPLE     PERIODS - TOTAL     PERIODS - TOTAL     REINDOS - NUM - UPRIGHT     ERODOS - NUM - TOTAL     N - SUPPLE     PERIODS - NUM - TOTAL     PERIODS - SUPPLE	Ölçön           30           30           173           0           2           2           40           6.9           2.87.5           0.60m           10.77.5           10.71.71           10.71.71           11.71           10.71.71           11.71           10.71.71           11.71           10.71.71           11.71           11.71           11.71           11.71           12.71           13.71           13.71           13.71           13.71           13.71           13.71           13.71           13.71           13.71           13.71           13.71           13.71           13.71		Anali Tip: Basing State	is Verileri an mittari 3'den 44.4 163 0 0 0 163 164 164 163 163 163 163 163 163 163 163 163 163	iazia mi?:	Ves Sempton An	anto EMe	(Symptom) ♥)	
20 S	Balans Software         Address         Address           PH         F         F           PH         F         F           International Software         Software         Software	Тарі: Акраломич (караломич) (	Bitterfell:           372           459           80           83           68           68           68           67           100           100           100           100           100           100           100           100           100           100		Em Monitor OF BELLO Worked OF BELLO Worked OF BELLO Worked OF BELLO OF BELLO OF BELLO OF BELLO Worked OF BELLO Worked OF BELLO Worked OF BELLO Worked OF BELLO Worked OF BELLO Worked OF BELLO OF Instance, ware and Of Bello Worked OF BELLO OF Instance, ware and Of Bello Of B	PRIDOS - SUPPLE PRIDOS - TOTAL PRIDOS - TOTAL REDOS MN - UMBELT REDOS - NN - TOTAL N - SUPPLE PRIDOS -	Ölçüm           10           13           13           13           2           2           4.0           6.8           6.8           6.8           6.8           6.9           0           0           0           11           0           481           481           69           0		Anali Bain Si Si Si Si Si R R Manifi Si Si Si Si Si Si Si Si Si Si Si Si Si	iz Veriferi Ata 11 Ata 14 14 14 14 14 14 14 14 14 14	iata m?	Ven Sempton Ar	alto EMe emplora Analto EMe	(Symptom) V	
<b>0</b>	كَلَوْنَ اللَّهِ اللَّهُ اللَّلَّةُ اللَّهُ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّلَٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَّٰ اللَ	Upition ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) (	Akteberleri :         v           0fcdim         37.2           45.9         53.1           6.8         6.8           6.8         6.8           6.7         10.2           1222.3         69.9           109.1         109.1           109.1         109.1		Mm         Mm           MARKED OF FACULATION         MARKED OF FACULATION           MARKED OF MARKED         MARKED OF MARKED           MARKED OF MARKED         MARKED O	1498/005-1397M 1498/005-1070L 1498/005-1000L 1498/005-1000L 1498/005-1000L 1498/005-1000L 1498/005-10000	Ocion           39           13           0           2           43           45           48           49           68           68           69           10           11           0           11           11           11           12           132           141           10           11           12           13           141           10           11           12           13           141           10           11           12           13           141           15           16		Anali Tip: Basin 31: 547: P. Basin 51: 547: 547: 547: 547: 547: 547: 547: 547	is Verileri an mitter 13 den 44.4 14.8 10.0 0 0 is Verileri as mitter 13 den 44.4 14.8 0 0	iata mi?	Veil Sergion Ar	anto EMe employ Analo	(§)mplon) <b>v</b> ] (§)mplon) <b>v</b> ]	
<b>So O</b> 5	كليفته (	UPBIGHT	Atterterlerl:           372           459           68           6.6           6.6           6.7           6.8           6.9           100           100           100           100           100           100           100           100           100           100           100           100           100           100		Eam No.Marcel of REQUE No.Marcel of REQUE No.Marcel of Long Fi No.Marcel of Long Fi Outperformation (Long Fi Outperformation) Defender REQUE No.Marcel of REQUE No.Marcel of REQUE No.Marcel of REQUE No.Marcel of Long Fi No.Marcel of Long Fi No.Marcel of Long Fi Outperformation Constitution (Long Fi No.Marcel of Long Fi Part (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution (Long A), where the Constitution	PRILODS - SUPPLIE PRILODS - TOTAL ERIDODS - TOTAL ERIDODS - NUN - LURISOFT ERIDODS - NUN - TOTAL ERIDODS - NUN - TOTAL ) concurs give 1 w do 2 gmm12 PRILODS - TOTAL PRILODS - TOTAL PRILODS - TOTAL - PRILODS - TOTAL - PRILODS - TOTAL - PRILODS - TOTAL - NUN - LURISOFT N - SUPARE - NUN - TOTAL - N - TOTAL - N - TOTAL - N - TOTAL - N - TOTAL - N - TOTAL	Oppm           30           30           30           31           32           32           49           6.8           2473           0           10           11           16           11           16           11           12           32		Anali Tao: Born 31: 347: P: P: P: P: P: P: P: P: P: P: P: P: P:	iz Verileri 14.4 14.4 100 0 0 iz Verileri 14.4 100 0 0 14.4	iata m?	Yesi Sergelon Ar	arto Elde	(Symptom) ♥	
<mark>°. ©</mark> 5	كلمكاني و	Та): Алдалаан (са. сулаанаан) (са. сулаанаан у илаанаан илаанаан у илаанаан у илаанаан	Batterirei:         V           372         459           459         68           63         68           63         63           64         63           67         67           102         100           103         100           104         100           105         100           106         100           106         100		Iom         Iom           NO.NECT OF ENLINE         NO.NECT OF ENLINE           POINT FEASIBLE         NO.NECT OF ENLINE           NO.NECT OF ENLINE         NO.NECT OF ENLINE           NO.NECT	PERIODS - SUPPRE     PERIODS - TOTAL     PERIODS - TOTAL     PERIODS - MINI - UPRIGHT     ERIODS-S MINI - SUMME     ERIODS-S MINI - TOTAL     N - SUMME     PERIODS - SUMME     PERIODS - SUMME     PERIODS - SUMME     PERIODS - SUMME     PERIODS - SUMME     PERIODS - SUMME     N - SUDME     N	Ölgöm           12           12           2           43           43           43           43           43           44           10           11           41           12           14           15           16           17           18           19           11           12           13           14           15           16           17           18           19           11           12           13           14           15           16           17           18           19           11           12           13           14           15           16		Anali Tip: Basing SAP: P. Anali Sap: Basing Sap: Basing Sap: Sap: Sap: Sap: Sap: Sap: Sap: Sap:	iz Verileri iz Verileri iz Verileri iz Verileri iz Verileri iz Verileri iz Verileri	iatia m?:	Vell Sergion Ar	valo EM	(§ymplen) ♥ (§ymplen) ♥	
<b>0</b>	Талыт болсонії, кліент 1995 т. 11 сля 288 № (4 лят.) рег Геланта прямі Мин. 1998 сля (4 лят.) прямі  сля кліента прямі  Сля (4 лят.) Паляне Сля (4 лят.		Batterieri:         V           07.02         07.02           03.1         08.0           03.1         08.0           03.1         08.0           04.0         09.0           057.2         09.0           09.9         100.0           109.9         100.0		Mm         Mm           MARKED OF MELLOW         MMARKED OF MELLOW           MARKED OF MELLOW         MMARKED OF MELLOW           MARKED OF MELLOW         MMARKED OF MELLOW           LONGET FETUNA M         LONGET FETUNA M           MARKED OF MELLOW         MMARKED OF MELLOW           MARKED OF MELLOW         <	PERIODS - SUPPINE PERIODS - FUNDAL PERIODS - MAN - SUPPINE PERIODS - MAN - SUPPINE PERIODS - MAN - SUPPINE PERIODS - SUPPI	Öçüm           39           13           2           43           43           43           43           43           43           43           43           43           43           43           43           43           43           43           43           43           43           43           441           441           441           441           441           450           450		Anali To: Born 31 347 94 94 94 94 94 94 94 94 94 94 94 94 94	is Verileri a miktari 3'dan 100 0 100 0 100 0 100 0 100 0 100 0 100 0 100 0 0 100 0 0 100 0 0 100 0 0 100 0 0 100 0 0 100 0 0 100 0 0 100 0 0 100 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0	latia m?:	Vei Sergion Ar	artio Ebio	(\$)mplom) ⊻ (\$)mplom) ∑	
<b>0</b>	Tabless Stockeel         Address         Address           pH         Constant         Constant           pH         Image: Constant         Constant           pmd. Min-V0900;         pmd. Min-V0900;         pmd. Min-V0900;           pmd. Min-V0900;         pmd. Min-V0900;         pmd. Min-Min-V0900;           pmd. Min-V0900;         pmd. Min-Min-V0900;         pmd. Min-Min-V0900;           pmd. Min-V0900;         pmd. Min-Min-V0900;         pmd. Min-Min-V0900;           pmd. Min-V0900;         pmd. Min-V0900;         pmd. Min-Min-V0900;           pmd. Min-V0900;         pmd. Min-V0900;         pmd. Min-V0900;           pmd. Min-V0900;         Qud. Qud. Qud. Qud.	UPROHT	s Kateterleri : v		Ean NUMBER OF RELIA NUMBER OF RELIA NUMBER OF RELIA NUMBER OF LODGE CONSTITUTION OF A STATE OF A STATE NUMBER OF RELIA NUMBER	PRILODS - SUPPAC PRILODS - TOTAL EREDOSS MIX - UMBOTT EREDOSS MIX - UMBOTT EREDOSS MIX - TOTAL - UMBOTT - N-SUPAC - NOTAL - SUPPAC - SUPP	Ölçüm           30           30           13           30           2           40           6.8           6.8           2473           70           70           70           71           72           73           74           75           75           76           77           78           79           70		Anali Tip: Bain Si Si Si Si Si Si Si Si Si Si Si Si Si	iz Verileri 144. 144. 144. 100 0 10 10 10 10 10 10 10 10	asia m?:	Vell Sergion A	valid Elve englon Analo	(\$)mpkm) V	
Sec. 2	Balans Motionali         Anternalis           pH         (Example           (Example         (Example           pH         (Example           (Second         (Example           pH-400         (Example           (Manualistic)         (Example           (Manualistic)         (Example           (Manualistic)         (Example           (Manualistic)         (Example           (Manualistic)         (Example           (Manualistic)         (Example)	UPBGHT	A Kateterleri : V 572 459 031 68 68 60 63 63 63 63 63 63 63 63 63 63		Lan Manual Control of Filling Manual Control of Filling Manual Control of Filling Manual Control of Filling Manual Control of Filling Physics Control of Filling Physics Control of Filling Manual Contr	2410005 - 509AE 2410005 - 107AL 2410005 - 107AL 2410005 - 107AL 2410005 - 107AL 241005 - 500A - 107AL 241005 - 500A 241005 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 241000 - 500A 2410000 - 500A 2410000 - 500A 2410000 - 500A 2410000 - 500A 2410000 - 500A 2410000 - 500A 2410000 - 500A 2410000 - 500A 2410000 - 500A 2410000 - 500A 2410000 - 500A 2410000 - 500A 2410000 - 500A 24100000 - 500A 24100000 - 500A 241000000000000000000000000000000000000	Ölçön           19           19           10           2           43           43           43           43           43           63           63           64           65           67           10           11           60           11           61           62           11           61           62           62           63           64           62           63           64		Anali Tip: 35: 347; P: 70; 81; 81; 82; 84; 94; 95; 84; 95; 84; 95; 94; 95; 94; 94; 94; 94; 94; 94; 94; 94; 94; 94	iz Verileri 144. 143 100 0 10 10 10 10 10 10 10 10 10 10 10	latia m?:	Vesi Sempton Ar	asto EM	(§ympken) ♥) (§ympken) ♥)	
<b>No S</b>	Tables Notes         Anter Notes           PF         F           Image: Second Se	UPRIGHT	s Kateterleri : v 37 2 45 9 53 1 6 8 6 8 6 8 6 8 6 8 6 8 6 8 6 8		International States of St	PERIODS - SUPINE     PERIODS - TOTAL     PERIODS - TOTAL     REINDOS - NUM - UPRIGHT     ERIODS - NUM - UPRIGHT     N - SUPINE     Success Table - Superiore     PERIODS - NUM - UPRIGHT     SUDAR BILL A 2 (VINIL)     Success Table - Superiore     Superiore - Superiore     Superiore - Superiore     Superiore - Superiore     Superiore - Superiore     Superiore - Superiore     Superiore - Superiore     Superiore - Superiore     Superiore - Superiore     Super	Öçüm           39           13           0           2           40           23           24           25           273           233           233           233           233           2           10           11           6           481           6           481           10           481           6           481           6           6           6           6		Anali Tip: Basin St. Sa: P. P. Anali Tip: Sa: Sa: Sa: P.	iz Verileri 14.4 14.4 100 0 10 10 10 10 10 10 10 10 10 10 10	iasia m?:	Veri Serrpton Ar	asto EH:	(Symptom ⊻)	
<b>S</b> S 5	Tabless Stockeel         Address         Address           pH         Constant         Constant           pH         Image: Constant         Constant           pmd.Min-URB/GHT         pmd.Min-URB/GHT         Pmmd.Min-URB/GHT           pmd.Min-URB/GHT         pmd.Min-URB/GHT         <	UPRIGHT UPRIGH	s Kateterkeri : V S72 459 571 459 66 66 66 66 66 67 547 1922 192 190 100 100 100 100 100 100 100		Eam Monitorial of RELIAN Workshop (Control (Control)) Workshop (Control) Obergin Teruson Obergin Teruson Obergin Teruson Obergin Teruson Obergin Teruson Named Control Named Control Named Control Contegin Teruson Named Control Contegin Teruson Named Control Contegin Teruson Named Control Contegin Teruson Named Control Contegin Teruson Obergin Teruso	PRIDOS - SUPINE PRIDOS - TOTAL ERIODOS NUN - URBATT ERIODOS NUN - TOTAL ERIODOS NUN - TOTAL N - SUPINE N - SUPINE N - TOTAL ) CRIMOS - SUPINE ERIODOS - NUN - URBATT ERIODOS - NUN - URBATT ERIODOS NUN - URBATT ERIODOS NUN - TOTAL N - SUPINE ERIODOS NUN - TOTAL N - SUPINE N - SUPINE N - SUPINE N - SUPINE N - SUPINE N - SUPINE	Ölçüm           30           73           0           2           4.0           2.8           2.4           2.4           3.6           3.6           3.6           3.7           0           0           10           11           641           201           0		Anali Tip: 35: 347; 9; 7; 9; 9; 9; 9; 9; 9; 9; 9; 9; 9; 9; 9; 9;	iz Verileri na miktar 13'den 143 100 0 0 iz Verileri 144 150 0 0	latia mr?	Veri Serrpton Ar	valo EM	(Sympton V	
<b>8</b> 8	كَلَيْتُ الْحَدْثَانِ اللَّهُ اللَّ	UPRORT	Batterferleri :         V           Ø(clium)         77.2           46.9         103.1           6.8         6.8           6.9         6.8           6.7         103.1           10.0         100.1           10.0         100.1           10.0         100.1           10.0         100.1           10.0         100.1           10.0         100.1           10.0         100.1		Nm         Nm           NVLNESC OF RFULLY         NVLNESC OF RFULLY           NVLNESC OF RFULLY         NVLNESC OF RFULLY           NVLNESC OF RFULLY         NVLNESC OF RFULLY           UNDERST FEASING         NVLNESC OF RFULLY           UNDERST FEASING         NVLNESC OF RFULLY           NVLNESC OF RFULLY         NVLNESC OF RFULLY           NVLNESC OF	2.PERDOS - 50PAE PERDOS - 107AL PERDOS - 107	Öçüm           32           3           4           4           5           43           43           43           44           5           45           46           5           475           6           9           10           11           43           44           9           10           41           42           9           10           43           9           10           43           9           10           11           12           9           13           14           15           16		Anali Tip: Basin 347 P. Anali Tip: 548 548 548 548 548 548 548 548 548 548	2 Vinitei 4 Vinitei 4 1 4 1 6 0 0 0 0 0 0 0 0 0 0 0 0 0	azla m?:	Vest Semption Ar	anto Ethi errition Anato anto Ethi	(Septen V	
<b>°., O</b> :	Tables Notes         Anternet           PM         Marcel           PM         Image: Control of the second s		Batterferi:         V           V         V           60         0           90         0           100         0           100         0           100         0		Eam Numerica of the Dub Numerica of the Dub Numerica of Long France Numerica of Long France Understrational Conference One of the Dub States Numerica of Long France Numerica	PRILODS - LUPINE     PRILODS - TOTAL     PRILODS - TOTAL     REIODS NW - UPRAUT     REIODS NW - UPRAUT     SUPPRE     N - SUPPRE     Subscript age of a general     subscript age of a general     REIODS - SUPPRE     subscript age of a general     subscript     general general     subscript age of a general     subscript age of a general     subscript age of a general     subscript age of a general     subscript age of a general	Oppm           30           30           30           30           2           2           30		Analita Tip: 35: 347: 9 7 8 35: 347: 9 8 35: 347: 9 7 8 35: 347: 9 247: 9 247: 9 247: 9 247: 247: 247: 247: 247: 247: 247: 247	2 Volleri 4 Volleri 8 Volleri 8 Volleri 8 Volleri 8 Volleri 9 Volleri	latia m?:	Veri Serriton Ar	anto EM emplom Analo	(Supplem) V	

Figure 2. The "pH Monitoring-Impedance-Symptom Analysis" page.

In our study, four GERD phenotypes can be automatically detected using the algorithm integrated into the system, as shown in Figure 3. Endoscopy examinations have been performed in many medical centers; therefore, the up-to-date endoscopy procedures used by the group studying reflux at Ege University are used by the developed system to determine the GERD phenotypes. If the endoscopy examination is not performed at Ege University, the most recent endoscopy examination procedure used by this other center is evaluated.



Figure 3. Flowchart of the GERD phenotype rules.

An important difference in the system is that, although many types of catheters and applications exist, the one desired can be selected and the resultant analysis can change accordingly, for example, to single-channel or dual-channel pH or bravo. Figure 4 shows the esophageal manometry page containing the embedded CC 3.0 rules; this algorithm automatically determines the phenotype of the patient. As a result, the developed system is not only an automation system but also contains rule-based algorithms on manometry, pH monitoring, and diagnosis. By means of these methods, a new original database about GERD with a large number of patients has been obtained. Based on these numbers, the Discussion section details the outcomes of this study.

Contraction Vigor :
■ Failed (DCI <100 mmHg+s+cm)
■ Weak (DCI >100 mmHg↓s↓cm, but <450 mmHg↓s↓cm)
■ Hypercontractile (DCI ≥8000 mmHg+s+cm)
Shormal (DCI >450 mmHglslcm but <8000 mmHglslcm)
Contraction Pattern :
Premature (DL <4.5 s)
■ Fragmented (Large break (>5 cm length) in the 20-mmHg isobaric contour with DCI >450 mmHgLs+cm)
Intact
Intrabolus Pressure Pattern :
Panesophageal pressurization (Uniform pressurization of >30 mmHg extending from the UES to the EGJ)
Compartmentalized esophageal pressurization (Pressurization of >30 mmHg extending from the contractile front to the EGJ)
EGJ pressurization (Pressurization restricted to zone between the LES and CD in conjunction with LES-CD separation)
Normal
SONUCLAR
Normal
AÖS gecilemedi
Achalasia outflow obstruction :
□ Type I achalasia (classic achalasia) (Elevated median IRP, 100% failed peristalsis (DCI <100 mmHglslcm))
Type II achalasia (with esophageal compression) (Elevated median IRP (>15 mmHg*), 100% failed peristalsis, panesophageal pressurization with 220% of swallows)
■ Type III achalasia (spastic achalasia) (Elevated median IRP (>15 mmHq*), no normal peristalsis, premature (spastic) contractions with DCI >450 mmHq s cm with ≿20% of swallows)
EGJ outflow obstruction :
EGI outflow obstruction (Elevated median IRP (>15 mmHo*), sufficient evidence of peristalsis such that criteria for tunes I-III achalasia are not met)
Major disorders of peristalejs :
Absent contractility (Normal median IRP, 100% failed peristalsis)
Distal conducting (normal median IRE) > 20% oremature contractions with DCI >450 mmHotstcm. Some normal neristals may be present
Hypercontractile explanation (archammer) (at least two scalles with CCL>8000 mmHnlsstern)
Tradiccius acontestas a
Encounted particular (x50% menetodes statutes)
Promote visions (color magnetice contractors and pol > 400 mining/s-cm)
rymonu -
Kesi Veri: anterior ▼ Kesi Uzunluğu: D
EQUAL: injent oncesi + rest tip: Lent Kak +
oncekitedavi: animasyon v
ekspiryum sonu LESP: li <del>jtem oncesi 🔻</del> ortalama bazal LESP: lijtem öncesi 🔻
intragastrik basınçı 🛛 işlem öncesi 🔍 İntraözofageal basınçı lişlem öncesi 🔍
Kaydet

Figure 4. The "Manometry Analysis" page.

Additionally, the CC 3.0 has been integrated into the system and 10 manometry diagnoses can be automatically made using the algorithm shown in Figure 5.

Another algorithmic contribution of the system is related to the questionnaires. Eleven questionnaires about GERD, adapted to Turkish, have been implemented on the system, and a digital platform through which patients can efficiently enter details from their mobile phones has been provided.

Finally, importantly, the system outputs all examinations, parameters, and results for each patient for the physicians to examine in detail. A sample of the output is given in Figure 6.



Normal Esophageal Motility

Figure 5. Flowchart of the CC 3.0 rules.

Print Zamani : 09-10-2020 14:59	l				
Hasta Bilgleri	Endoskopi Tarih : 16-12-2009				
Dosys No : esses TC No : esses	Yer : Bozyaka ( Belirtilmi Açıklama :	amiş (Bozyaka))			
Ad Soyad : manatosom Cinalyst : Erkek Doğum Tarhi : essenasses Yaş : (%	1) Mide (Eritematőz antr. 2) Özofagus (Özofagusti	al gastrit) a polip)			
Adres 14.6 FVLER OZDERE - Sehir: Izmir MENDERES/JAMB	- Tarih : 8-1-2010				
Telefon : Cop Telefon : Ecosta : Hata Tbi Rafa (Normal)	Yer : Ege (Doç.Dr. Rukiy Açıklama :	e VARDAR)			
Heldm Adz : Ruklye VARDAR Obnderen Heldm : DR.EREN AKÇIÇEK Obnderen Bilm : Yok RES :	1) Mide (Polipektomi) 2) Mide (Enternatöz antr	al gastril)			
Apitama : Boy/Klo/KBI :	<ol> <li>Özofagus (Özofajit Gr 4) Özofagus (Özofagusti</li> </ol>	ade B) a polip)			
Yekonmeler Binnie Desensei - Onnellerin Silve - 0. Silviket - Silvik : Haftada bikag (pgl 200. 100 Tarbi - 1.12.2010	5) Ozofagus (Hiatus herr	risi (sliding)4 cm)			
Produst         Derecest         Chicelina         Gale 0.1         Globel 1.1         Kere         Pri visorito         Family 11/22010           Regúritasyon         Derecest i Chicelina         Súre 1.5 yil         Sidet :-         Skikk : Her gûn         PPI : %25 inden az         Tanhii : 11/2:2010	Tarih : 19-2-2010 Yer : Ege (Doc.Dr. Rukiy	e VARDAR)			
Oksimitik         Demodel : Chcelikizi:         Strice:         Strick:         PPI :-         Tanhi: 1:12:2010           Epigastik agri         Demodel : Chcelikizi:         Sife: 0 -         Siddet :-         Sidk: -         PPI :-         Tanhi: 1:12:2010	1) Özofagus (Hiatus heri	nisi (sliding)4 cm)			
Gegrime Dereces : Oncerece June 10 - Suder :- Sixex :- PH1 :- Francist :- 122010	Tarih : 2-2-2017				
Vers  Vers	<ul> <li>Tele Collino Anna Alexandro Alexa</li></ul>	dogru uzanan çaplari (2-7 Hatus dlafragmatikus is Idi S 4 mik görünümdedir. Korpı olarak saramadigi izlenr normal. Duodenum 2. s n Korpus	mit asstudi deglen bizki ile bidemnyen liver enzynatiz idend. Z (ziglii 33 om/64, dizent, gustis pillen 37 om/64, assta bir hem posu vedi r. Pa si mitakza nomi, pos granida 3 4 mit mitaki polje biadu anomitaki bigk handu konto 45 mit begreten birget birget poljegi kongu konto 45 3 Premtekanovch keda nazi, bu pozijonata hem posu nel br seldde glatendamekter. Antum 6 1 ve koputan 52 biggeler alnd. granet mulicizasi nomatik.		
Sigara : Kullanmiyor~ Alkol : Kullanmiyor~ Kilo Kaybi : Analjezik : Tarihi : 1-12-2010	Mide korpus küçükkurva Endsokopik eritematöz p	turda polip angastrit			
Kontroller	2) Mide (Mide polici) 2) Mide (Enternatõz para 2) Arategura (Arateja Ara	pastrit)			
Terris 42-150/7 [FFFF et on comano Lawordon in mante experimus, Ucask 2017 de zona geprimis yogun NSAII kultanmak zorunda katmis. Su an PPF ve Gaviscon a Targime i kultaniale ve obs kidelet priozis negolitizatoru metvozi. Endoskoj tijektari perekinse operasyon čnendil. Tarih: 13-2-2017 - 21,012,012 Ozade B čzotaját, Barnet? Dr.Gazi Yörlük, Biz: Barnett degli.	4) Özofagus (Hiatus herr	nisi (sliding)4 cm)			
Tarih : 2-2-2017 - Grade B čeolaji, HH 4 om, Histos içinde polip, midede polip, EE Pangestrii, Dr.Murat Buyruk, Bs:: Antrum mukozasi, Körpus mukozasi, Köçük kuruvatör fundik gland polibi. HPU). PPI - Gay davam. 270 usr: 0 usr.	Tarih : 6-11-2019 Yer : Ege (Prof.Dr. Serha	# BOR)			
Tarih: 25-10-2019 yea, c.yu uma ugo wagma. ourewu rekestigi xit bazen z x kutammatare karan kuzunca kani k	Açıklama : ÖZOFAGUS Z çizgisi 33, cm?de, düz	enli, gastrik pillerin heme	n proksimalindedir. Hiatus diafragmatikus ise 37. cm?de olup, arada büyük bir hemi posu vardir. Pos içi mukoza in saran ülasehenozv lezundia rizlendi. AVS sürekli ank.		
Tarn : 10-12-2019 [ - pri patolojik. OGD PPI siz yapildi. D čeolajit. Op yarar var. ES s2, Fam 40 mg x 1, Konseye gelecek. Egede op istiyor.	MIDE Midede bol safra var. Ka Betrofieksiyonda kardia	rdia , fundus , korpus ve pilierinin endoskopu tam	antrum normal görönümdedir. volarak saramadigi iztermistik, bu pozisyonda herni posu net bir sekilde gözlenebilmektedir.		
EX PUNDURX Yok	Pilor formedir. DUODENUM Bulbus forme, mukozasi	normal. Duodenum 2. s	igment mukozasi normaldır.		
Annelyst Add: Inguinst herri operasyonu	Hizli Üreaz Testi Antrur TANI Bilvík Hatur Hamini	n Korpus			
1.48m 1 - 1 - 1950 pmm8ty81 Ad: 1 Kootee anlog //// Tanh 1 - 1 - 2015 Amelyat Ad: Kolestatektomi Tanh 1 - 1 - 2015 Amelyat Ad: Kolestatektomi	Eroziv özofajit LA D 1) Özofagus (Özofajit Gr	ade D)			
Tarih : 1-1-1900 Aneliyat Adi : Mottati Tarih : 1-1-1900 Aneliyat Adi : meniskus op.	2) Özofagus (Hiatus hen	nisi (sliding)4 cm)	(1)		
(a)			(D)		
· · /	Radyoloji	1	Notlar : ÔMD TETKIKI:		
Patholis         Trans. 16.42010           Ver. (Sign. Status)         Status)           Status)         Status)			Oral yoldan verlien opak madde faanksten karduiga kader takintisis olarak isternistis. Poetagus liimen geeralig, konstatis ve makaar ganian romaafar. Met mise at ölabioek baryum takintis saptamananistir. Qakim pensiatistimi, bubas ve dudemä are normadia. Akat näise at ölabioek baryum takintis saptamananistir. Qakim oraaatisd haita horni le oyumb olabioeka kardana harakapasathis kilosia vanaia dogsu ye degatirdigi Tendekindung potiopronunk hastaya valakak manennasi yepäriaak ekis olunan görüntülerde GOR ile uyumu opak madeini mideelm defaguas kapai üsennatir.		
Patiols: Yours: I rolu density density and accurate tables, regeneral degradative exploitacion vere tables cannot support a second accurate a second ac	Tarih : 1-3-2010	Yer : Ege	SONUC GÖR ve histal herri ile uyumlu bulgular.		
(Ian 19 korn) Ver (ga Ner (g			Saygilarinta, Dr. SECIL CAM U.m. Cr. ANNET SEVER		
2) Mile (Korpus)			Notur : ÚST BATIN BT, ALT BATIN BT, 3 BOYUTLU BT:		
Tarih : 16-12-2009 Yer : Bozyska	}		IV yoldan 100 cc non ?iyonik iyotlu kontrast madde venimistir.		
Patolojk Tan: : Patolojk Yorum : midere alt biyopsi čimeginde yangi (++), sistivite (-), atroll (-), intestinal metaplazi (-), Hoykeri (+), bazi besterde nikiker degisikikise izlenmistr.	-		Solid ve içi bös organ lokalizasyon takip ve komsuluk iliskalerini degerlendirmek amacıyta MPH teknigi kullanilarak 3 böyütü inceleme yapılmıştır.		
Ozorogijena da upropri oringene pogra anka obijar (ok kar jeste oprin zeministru) a anka soopenia aan gootenissu, se anka ben gri canta benji ruana r mecutari. IN vortem ile bu alanda CD 34 +,Stokeratin -Ayrica PS3 tek tilk hücrede + ve Ki 67 dr. Lezyon subepitelial yerlesimlidir. Kesin histopatolojik tani ijin polipektomi gerekildir.			Terkke dam brakk kesterinn degeherdarmende sol aktiger at too taltra boaa segmen duzvynbe perferit verleam gotteren valkaat 7mm oppinde non spesifik paranismal nodel aktika oelemisti. Sol akcigerde paramediastinal alanda ateiekitatik bantlar izbernektedir. Ozelagokardiak bileske kraniale dogru ver denizitratik. Gehingmit bilden bi homin iki susminider.		
1) Mide (Antrum) 2) Özotagus (Distal Özotagus)			Karaciger boyut, kontur ve parankim dansitesi normal görünümdedir. Hepatik ve portal venöz sistem normal görünümdedir. Seiner ven ve SAV de patient olarak izlenmiktedir. Saina kesesi hidropik olup duvarda		
* Tarih : 2-2-2017			Kontrastlanma aritsi ve perikolesistik alanda dolom-sivi bulgulari dikkasi çekmis olup bulgular alak tköresisti destektemektedir. Bu açidan US ile baki daha uygun olacaktir, Intra hepatik safra yollarında anlamli dilatasyon mevcut degildir. Koledok çapi da en genis yerinde 9mm olarak öçürmüstür. Parkenea ödemi göründedir.		
Patolji Tani : I-MIDE, ENDOSKOPK BIYOPSI, ANTRUM; ANTRUM MUKOZASI II-MIDE, ENDOSKOPIK BIYOPSI, KORPUS; KONJESYONE KORPUS MUKOZASI			Peripandreaux autoa entistmatur cogese dansteer ve immi six dansteen dickat gewoekser. Henpandreaux alanda fuziom sekilde kisa akstart im den küçük keri bezleri telennistir. Bulguar akut pankranti ile urumtudur. Neiroz bulgusu ayrit edimemistir. Dalak, bilateral şürenat bezler ve bözekete olagan ekiterisetekete. Sekildeste bilande 20 den expension bestelet itel excende anetere etient extension. Istaatised		
III-MIDE, ENDOSKOPIK POLIPEKTOMI, KORPUS, KÜCÜK KURVATUR; FUNDIK GLAND POLIP IV-MIDE, ENDOSKOPIK BIYOPSI, HATUS HERNI IÇERISI; KONLESYONE KORPUS MUKOZASI Pablolik Yoma: 'H Paledi Admunda (), Komuska (), Komuska (),	Tarih : 1-4-2014	Yer : Ege	gonutanimetari, odu odchemi normal dir Kolon anstanno konsen ken er byterina teryolina uksey omisari interana ans läme kalibrasyonlari normal dir Kolon anstanno yaygin diverkiller dikkat gekmistir. Pelvik kesiterde mesane yeteri doulukta degidir. Prostat boyuttiri artmistir. Sannainde kalisikasyoniar diskat devinekkelit. Bu addan klimik devertendirme kontin. Prostat boyuttiri artmistir.		
1) Mile (Antum) 2) Žeždaus (Ostal Čezdaus)			görünümdedir. Rektum, perirektal yag planlari açiklir. Abdominal aorta ve dallarında aterosklerotik plaklar dikkali çekmistir.		
3) Mile (Korpus)			Kemik yapilarda dejeneratif degisiklikler iztenmistir.		
Tarih :6-11-2019 Yer : Eoe					
Patolojk Tani : I-MIDE, ENDOSKOPK BIYOPSI, ANTRUM; KRONK AKTIF GASTRIT, HAFIF SIDDETTE II-MIDE, ENDOSKOPK BIYOPSI, KORPUS, ODEML KORPUS MUKOZASI III-ZATOFAUIS ENDOSKOPK BIYOPSI, OZOFALIT	1		SONUC (Akut pankreatit ile uyumlu bulgular. Nekroz bulgusu saptanmamistir.)		
Patolojik Yorum : H.pylori, Antrumda (-), Korpusta (-) 11 Mide (Antrum)			(AKUT PANKREATIT)		
2) Özofagus (Distal Özofagus) 3) Mide (Korpus)	]		Saygitarimta,		
			Dr.ERMAN KURT Prof. Dr. MUSTAFA HARMAN		
$(\mathbf{c})$			(d)		
(C)			(u)		
Tarih: 11-0-2010 Kabert Tari # Kanal Subu	Açıklama : Les Bestino Pressure : 7				
1. Tan) 2. Tan)	NORMAL DÜSÜK AÖSF				
pH Metri Tarih : 10-11-2010	Açıklama :				
Čitpim Tipi : Saidece pHiMetri Kateter Tipi Adi : kili pH;15 cm arakiki	Kateter Takılma Yöntemi Tip Araştırma Kateteri : Yok	si : AÖS -5 cm			
Sonuc : Patololik asit reft)	Semptom Analizi : Tipik Semptom Analizi (Sym YAPILMAMIS!	ptom) -> BASIMLA ALAI	KALI GÜNCELLEMESİ		
DH-d %- TOTAL -0 9/Provinal 21 9/Fictal	Tipik Sempton Analizi (Sym YAPILMAMIS! DeMeester SCORFIPL + 1 21	ptom) -> BASIMLA ALAI	VALI GUNCELLEMESI		
	000100/10				
Taniar					
Tanı Adı : Eroziv Ozofajit Tip Adı : Ozofagus Tanı Adı : Eroziv Ozofajit Tip Adı : Ozofagus		Tarih : 1-5-2019 Tarih : 21-1-2020			
Tadavi ve Bac					
lisç Adı : Gariston Advance Oral İstadar	Süre : 0 Hatta	Doz : Belirtilmemiş	Tarih : 2-2-2017		
Söspänsityön Ans Başlık Adı : Protorn Eliken Madde : İlaç Adı : Ppi Pompesi Inhöböten Balafalmennia	Süre : 0 Hatta	Doz : Belirálmemiş	Tanh : 2-2-2017		
Diger Tedevi					
Konsev Kararlan					
Konsey Kanafan Tarih : 1-12-2010 Yer : Ege Açıklama : Hasta isters	90.	Operasyon Adı : Nissen	Konsily Karan : Op. Uygun		
Konservin         Year         Ege         Apkkama: Heads Miler           Tach: 12-1020         Yer: Ege         Apkkama: Heads Miler           Tach: 12-1020         Yer: Ege         Apkkama: Heads Miler	se	Operasyon Adı : Nissen Operasyon Adı : Nissen	Konsky Karan : Op. Uygun Konsky Karan : Op.		
Konsey         Konsey         Konsey         Applement           Tath: 1:3:4000         Yer: Ege         Applement         Applement           Konsey         Yer: Ege         Applement         Applement	50. 	Operasyon Adi : Nissen Operasyon Adi : Nissen	Lonny Kam: Op.		
Konsel/Kenrufun         Yer         Ege         Apktama: Hesta stern           Tarih: 1:3 4 0000         Yer : Ege         Apktama:           Konställsseycinter         -         -	ie.	Operasyon Adi : Nissen Operasyon Adi : Nissen Pe	Compy Name : Op.         Company Name : Op.           Company Name : Op.         Company Name : Op.           Com.         C		
Konstellkamportan     Yerr : Ege     Apstanna : Hesta siter       Tarih : 3-4 3000     Yerr : Ege     Apstanna :       Konstöllkamportar     Konstöllkamportar	e)	Operasyon Adi : Nissen Operasyon Adi : Nissen Pr	00000000000000000000000000000000000000		

**Figure 6.** A general overview of the examinations, the parameters, and their results for a sample patient: (**a**) history, complaints, controls, additional diseases, and operations; (**b**) endoscopic values; (**c**) pathologic values; (**d**) radiologic values; (**e**) manometric values, pH monitoring, ultrasound results, diagnosis, medicine, other treatments, council decisions, and consultations.

## 3. Results

Patients who underwent all examinations were evaluated in the experimental analyses. The total number of questions, total number of answers, total number of questionnaire entries, and total amount of data obtained as a result of these examinations are given in Table 1. Until March 2020, 189,765 data items were obtained with only the GERD Question Form, with 66 questions and 353 answers, while a total of 613,715 questionnaire data items were obtained for all questionnaires. This resulted in a large dataset and provided proof of the importance of studies in the field of GERD.

	Total Questions	Total Answers	Total Entries	Total Amount of Data
QoLRAD1	12	84	4276	48,917
QoLRAD2	25	175	1723	38,800
GERD Question Form 1	57	238	653	33,942
GERD Question Form 2	66	353	5041	189,765
GERD Question Form 3	81	444	1873	185,774
SF-36	11	149	5399	119,252
Otolaryngology Form (11)	20	115	1446	21,196
Otolaryngology Score (11) GERD	9	28	1602	10,603
Postoperative Symptoms Question Form	22	96	156	2922
RDO	2	72	82	906
Eckardt Score	5	17	10	50
Total	310	1771	22,261	613,715

Table 1. Questionnaires and their total numbers of questions, answers, and entries.

An advantage of the 11 questionnaires used in the system is that some data were recorded before treatment, some were recorded during treatment, and some were recorded after treatment. Thus, concealed inferences and connections can be revealed in light of the analyses performed using the common data pool that contains this big data. In addition, if these data are handled in conjunction with other examinations and treatments, hidden relations for GERD can be discovered. Additionally, such a data pool is now available for use.

Endoscopic diagnoses have the most important role in the determination of GERD phenotypes because the first step in a GERD phenotype algorithm is to check endoscopic diagnoses. For example, if a patient has an endoscopic diagnosis of esophagitis grades A, B, C, or D, a phenotype of erosive esophagitis can be determined without considering any pH monitoring results. Table 2 shows the number of each phenotype in the database, with the erosive esophagitis phenotype making up 60% of all phenotypes. Therefore, the GERD phenotype algorithm in the developed system first evaluates securable endoscopic operations, such as the operations in the reflux study group of Ege University. In the beginning, the total number of patients was 6234. However, after the data preprocessing phase, 2052 patients had features meaningful for determining their GERD phenotype. Therefore, the number of total cells in Table 2 is 2052.

Before this addition to the algorithm, the accuracy in predicting the phenotypes was approximately 90%. After the addition, the accuracy improved to 100%. These accuracy tests were performed by expert physicians, and the results were manually checked one-byone. The diagnoses of the patients were made by gastroenterologists working in the field of GERD. Before using the AI module, the results of all patients were manually determined by these physicians according to their patient histories, endoscopic findings, classical or high-resolution manometric findings, and 24 h intraesophageal impedance–pH monitoring or ambulatory capsule pH monitoring findings, without knowing who the patients were. Then, the results of the AI module were compared with these manual results. Additionally, the confusion values, including diagnostic performance measures, were calculated. The precision, recall, and F-measure values were all 100%.

In Table 2, the second most common phenotype is non-erosive reflux disease, making up 28% of all phenotypes. Moreover, both of the most common phenotypes are 4% more likely to occur in males than in females. For the other phenotypes, the third most common phenotype is functional heartburn, making up 8% of all phenotypes, and the least common phenotype is reflux hypersensitivity, making up 4% of all phenotypes. These two phenotypes are encountered in females more often than in males. Reflux hypersensitivity is 60% more likely to occur in females than in males, and functional heartburn is 43% more likely to occur in females than in males. With respect to the age distributions in Table 2, all phenotypes are more often observed in people between 30 and 60 years old, at a rate of 71%.

Reflux Non-Erosive Erosive Functional Reflux Hypersensi-**Esophagitis** Heartburn Total tivity Disease (EE) (FH) (RH) (NR) 12 48 1008 Male 641 307 590 49 121 284 1044 Female Age (10-19) 18 4 2 10 34 Age (20-29) 119 8 18 60 205 Age (30-39) 271 19 42 127 459 Age (40-49) 298 13 49 149 509 299 37 Age (50-59) 13 144 493 169 19 77 268 Age (60–69) 3 2 Age (70-90) 57 1 24 84 169 (8%) 591 (29%) 2052 Total 1231 (60%) 61 (3%)

Table 2. Sociodemographic characteristics of the GERD phenotypes.

For the CC 3.0 phenotypes analysis, all phenotypes in the developed database were considered, with ineffective esophageal motility making up 45% of all phenotypes. Additionally, ineffective esophageal motility is 10% more likely to occur in males than in females. Moreover, the second most common phenotype is type II achalasia, making up 23% of all phenotypes. Furthermore, type II achalasia is 35% more likely to occur in females than in males. On the other hand, EGJ outflow obstruction, distal esophageal spasm, and fragmented peristalsis phenotypes are observed in quite a few people. In addition, the other four diagnoses—type I achalasia, type III achalasia, absent contractility, and hypercontractile esophagus—are almost equally encountered in females and males. With respect to the age distributions, all phenotypes are observed more often in patients who are more than 40 years old, at a rate of 65%. Accuracy tests were performed by the physicians, and the CC 3.0 phenotype results were manually checked one by one, obtaining an accuracy of 100%. Additionally, confusion values, including the diagnostic performance measures, were calculated. The precision, recall, and F-measure values were all 100%.

Table 3 shows the numbers of each phenotype in the developed database, with the ineffective esophageal motility phenotype making up 45% of all phenotypes. Additionally, ineffective esophageal motility is 10% more likely to occur in males than in females. In Table 3, the second most common phenotype is observed to be type II achalasia, making up 23% of all phenotypes. Furthermore, type II achalasia is 35% more likely to occur in females than in males. Additionally, EGJ outflow obstruction, distal esophageal spasm, and fragmented peristalsis phenotypes are observed in quite a few people. In addition, the other four phenotypes—type I achalasia, type III achalasia, absent contractility, and

hypercontractile esophagus—are nearly equally encountered in females and males. With respect to the age distributions in Table 3, all phenotypes are observed more often in patients more than 40 years old, at a rate of 65%. Accuracy tests for the CC 3.0 phenotypes were again manually performed by the physicians, and the results were checked one by one, obtaining an accuracy of 100%.

	Male	Female	Age < 40	Age $\geq$ 40	Total
Type I achalasia (classic achalasia)	7	7	5	9	14 (11%)
Type II achalasia (with esophageal compression)	10	21	10	21	31 (23%)
Type III achalasia (spastic achalasia)	4	4	1	7	8 (6%)
EGJ outflow obstruction	1	0	0	1	1 (1%)
Absent contractility	4	4	2	6	8 (6%)
Distal esophageal spasm	1	0	0	1	1 (1%)
Hypercontractile esophagus (jackhammer)	5	4	0	9	9 (7%)
Ineffective esophageal motility	37	23	29	31	60 (45%)
Fragmented peristalsis	1	0	0	1	1 (1%)
Total	70	63	47	86	133

Table 3. Socio-demographic characteristics for the CC 3.0 phenotypes.

Figure 7 shows the distribution of the number of patients from January 2015 to March 2020. The developed system started to store patient data in the database in 2017. The number of patients included in 2015, 2016, 2017, 2018, and 2019 was 373, 372, 577, 794, and 652, respectively. The number of patients included in January and February 2020 was 129; so, for all months in 2020, we predicted that  $129 \times 6 = 774$  patients could be stored in the database. Thus, it is noted that, since a transition to using the developed system in 2017, it has been observed that the number of patients, which was around 400 beforehand, increased to 800.



Figure 7. A graph of the patient count distributions from 2015 to 2020.

Moreover, the database is accessible only on campus, with any off-campus access only available with explicit permission from the IT Department of Ege University. Data security was ensured by following personal data protection procedures. Finally, it can be noted that this automation and decision support system improves the performance of physicians by nearly two times for patient care, diagnosis, and treatment management.

### 4. Discussion

In the field of gastroenterology, a medical information system was first implemented in 1984. That system had a DSS with a simple knowledge base and statistical structure [12]. Reporting by querying databases was seen next, as described in another gastroenterology study [13], and examples developed for specific purposes, such as drug tracking systems, were then implemented [14]. Currently, AI studies in gastroenterology have raised awareness about this subject worldwide [15,16]. These studies were performed to search for solutions for different sub-disciplines in gastroenterology; however, no comprehensive information system relating to GERD has so far been widely used in the world. Additionally, the main epidemiology studies were conducted in developed western countries. However, Turkiye has a different GERD profile. While the main complaint presented in developed western countries is a burning sensation behind the breastbone, in Turkiye, regurgitation is the most common symptom. Similarly, the Barrett problem, which is a cancer-related subgroup of reflux, has a prevalence of 10% in developed countries, while its prevalence is about 1% in Turkiye. Moreover, erosive esophagitis C and D are also less common [17,18]. Therefore, to represent the different realities in Turkiye, storing data in an environment where comprehensive analyses can be carried out will be of value. However, a central database of all records and data files stored in Turkiye has not previously been available until now.

This study represents the first time that a database and information system for GERD in Turkiye has been developed and published to improve medical workflow, to monitor patients, and to help physicians make decisions at various stages using machine learning algorithms.

Studies about reflux previously performed by our group have been highly cited and have come to the fore in the literature [19]. These studies could only have been carried out with a large number of patients. Additionally, our studies have been referenced in recent publications [17]. In order to achieve this structure, which includes an increasing number of patients, extensive computer support has been required. All the requirements for the automation and decision support system were influenced by feedback from our team.

Machine learning and deep learning techniques, which have demonstrated significant benefits and shown successful results, are also used in the field of gastroenterology. Illustrative examples include the following: automatic endoscopic scoring was performed using machine learning for ulcerative colitis, which manifests over the long term [17]; a machine-learning-based scoring system was developed to screen for high-risk esophageal varicose veins [20]; a machine learning model with better performance than clinical risk scoring systems for upper gastrointestinal bleeding was implemented [21]; machine learning algorithms were used to classify patients with constipation [22]; a deep learning model that can detect anterior gastric cancer symptoms was developed [23]; and, using another deep learning model, endoscopic diagnosis and treatment planning were implemented for colorectal polyps [24]. As a result of using this system in the successful studies described, a large database has been created and the use of machine learning and deep learning techniques has been facilitated.

Patients' medicinal treatment and responses to proton pump inhibitors (PPI) have been recorded in the developed system, which has allowed for quality-of-life and PPI response studies to be conducted. For example, up-to-date PPI threshold values specific to GERD phenotypes can be determined without fixing the PPI response to 50% [25]. Furthermore, the validity and reliability of the QoLRAD questionnaire in patients with gastroesophageal reflux disease for the Turkish population have been assessed [26].

Examples of studies implemented to identify sub-phenotypes, such as studies using automated phenotyping for type 2 diabetes [27], as well as studies determining the sub-phenotype of liver diseases using hierarchical clustering [28], were identified. By means of the developed system, GERD patients are automatically clustered into the phenotypes of erosive esophagitis, reflux hypersensitivity, functional heartburn, or NERD. Moreover, GERD patients can be automatically classified according to their manometry results using the CC 3.0 rules specified in [29].

In conclusion, healthcare personnel can now access information from any location using a mobile device, such as a cell phone or tablet, and due to the capabilities of the developed system, health personnel's efficiency in caring for patients has increased. Additionally, AI studies on reflux have increased [30–32].

**Author Contributions:** All of the authors participated in the study. Y.D.: conceptualization, methodology, investigation, formal analysis, resources, and acquisition of data; S.B.: interpretation of data, supervision, project administration, and funding acquisition. All authors have read and agreed to the published version of the manuscript.

**Funding:** This study was funded by the Ege University Scientific Research Projects Coordination Unit, project number 2.101.2015.0078.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

**Data Availability Statement:** The data are available upon request via correspondence. Ethical committee confirmation number: 2017-5.1/49.

**Acknowledgments:** This study is supported by the Reflux Study Group of Ege University. We especially thank the physicians in the group for their help in validating the accuracy tests.

Conflicts of Interest: The authors declare no conflict of interest.

### Abbreviations

The following abbreviations are used in this manuscript:

GERD	Gastroesophageal Reflux Disease
CC 3.0	Chicago Classification 3.0
DSS	Decision Support System
AI	Artificial Intelligence
NERD	Non-erosive Reflux Disease
QoLRAD	Quality of Life in Reflux and Dyspepsia Questionnaire
SF-36	Short Form-36
RDQ	Reflux Disease Questionnaire
MMS	Medical Measurement Systems
PPI	Proton Pump Inhibitors

### References

- 1. Kök, M.; Çekin, Y.; Çekin, A.H.; Uyar, S.; Harmandar, F.; Şahintürk, Y. The role of Blastocystis hominis in the activation of ulcerative colitis. *Turk. J. Gastroenterol.* **2019**, *30*, 40–46. [CrossRef]
- 2. Bulut, E.A.; Törüner, M. The influence of disease type and activity to sexual life and health quality in inflammatory bowel disease. *Turk. J. Gastroenterol.* **2019**, *30*, 33–39. [CrossRef]
- 3. Tongtawee, T.; Simawaranon, T.; Wattanawongdon, W.; Dechsukhum, C.; Leeanansaksiri, W. Toll-like receptor 2 and 4 polymorphisms associated with Helicobacter pylori susceptibility and gastric cancer. *Turk. J. Gastroenterol.* **2019**, *30*, 15–20. [CrossRef]
- 4. Van Brunt, E.E. The Kaiser-Permanente medical information system. Comput. Biomed. Res. 1970, 3, 477–487. [CrossRef]
- Winter, A.; Haux, R.; Ammenwerth, E.; Brigl, B.; Hellrung, N.; Jahn, F. Health information systems. *Health Inf. Syst.* 2010, 1, 33–42. [CrossRef]
- Huff, S.M.; Craig, R.B.; Gould, B.L.; Castagno, D.L.; Smilan, R.E. A medical data dictionary for decision support applications. In Proceedings of the Annual Symposium on Computer Application in Medical Care, Washington, DC, USA, 4 November 1987; pp. 310–317.
- Farooqui, N.A.; Mehra, R. Design of a data warehouse for medical information system using data mining techniques. In Proceedings of the Fifth International Conference on Parallel, Distributed and Grid Computing, Solan, India, 20–22 December 2018; pp. 199–203. [CrossRef]
- 8. Mishra, S.; Panda, M. Artificial intelligence in medical science. Intell. Syst. Healthc. Manag. Deliv. 2019, 1, 306–330. [CrossRef]
- 9. Currie, G.; Hawk, K.E.; Rohren, E.; Vial, A.; Klein, R. Machine learning and deep learning in medical imaging: intelligent imaging. *J. Med. Imaging Radiat. Sci.* **2019**, *50*, 477–487. [CrossRef]
- Agrawal, S.; Singh, B.; Kumar, R.; Dey, N. Machine learning for medical diagnosis: A neural network classifier optimized via the directed bee colony optimization algorithm. *U-Healthc. Monit. Syst.* 2019, 1, 197–215. [CrossRef]
- Habermann, W.; Schmid, C.; Neumann, K.; DeVaney, T.; Hammer, H.F. Reflux symptom index and reflux finding score in otolaryngologic practice. J. Voice 2012, 26, 123–127. [CrossRef]
- 12. Spiegelhalter, D.J.; Knill-Jones, R.P. Statistical and knowledge-based approaches to clinical decision-support systems, with an application in gastroenterology. *J. R. Stat. Soc. Ser. A* (*Gen.*) **1984**, *147*, 35–58. [CrossRef]
- Kuhn, K.; Gaus, W.; Wechsler, J.G.; Janowitz, P.; Tudyka, J.; Kratzer, W.; Swobodnik, W.; Ditschuneit, H. Structured reporting of medical findings: Evaluation of a system in gastroenterology. *Methods Inf. Med.* 1992, 31, 268–274. [CrossRef]

- Dormann, H.; Criegee-Rieck, M.; Neubert, A.; Egger, T.; Levy, M.; Hahn, E.G.; Brune, K. Implementation of a computer-assisted monitoring system for the detection of adverse drug reactions in gastroenterology. *Aliment. Pharmacol. Ther.* 2004, 19, 303–309. [CrossRef]
- 15. Ruffle, J.K.; Farmer, A.D.; Aziz, Q. Artificial intelligence in gastroenterology. *Precis. Med. Investig. Pract. Provid.* **2020**, 343–350. [CrossRef]
- 16. Adadi, A.; Adadi, S.; Berrada, M. Gastroenterology meets machine learning: Status quo and quo vadis. *Adv. Bioinform.* **2019**, 2019, 1870975. [CrossRef]
- 17. Bor, S. Reflux esophagitis, functional and non-functional. Best Pract. Res. Clin. Gastroenterol. 2019, 40, 101649. [CrossRef]
- Bor, S.; Kalkan, İ.H.; Çelebi, A.; Dinçer, D.; Akyüz, F.; Dettmar, P.; Özen, H. Alginates: From the ocean to gastroesophageal reflux disease treatment. *Turk. J. Gastroenterol.* 2019, 30, 109–136. [CrossRef]
- Bor, S.; Mandiracioglu, A.; Kitapcioglu, G.; Caymaz C.B.; Gilbert, R.J. Gastroesophageal reflux disease in a low-income region in Turkiye. *Am. J. Gastroenterol.* 2005, 100, 759–765. [CrossRef]
- Bossuyt, P.; Vermeire, S.; Ferrante, M.; Makino, T.; Bisschops, R. Automated real time endoscopic scoring based on machine learning in ulcerative colitis: Red density reliability and responsiveness study. *Endoscopy* 2019, *51*, 80–81. [CrossRef]
- Shung, D.L.; Au, B.; Taylor, R.A.; Tay, J.K.; Laursen, S.B.; Stanley, A.J.; Dalton, H.R.; Ngu, J.; Schultz, M.; Laine, L. Validation of a machine learning model that outperforms clinical risk scoring systems for upper gastrointestinal bleeding. *Gastroenterology* 2020, 158, 160–167. [CrossRef]
- 22. Ruffle, J.; Tinkler, L.; Emmett, C.; Aziz, Q.; Farmer, A.; Yiannakou, Y. PWE-097 Machine learning can accurately classify chronic constipation patients by symptom burden using pain measures alone. *Gut* **2019**, *156*, 590–591. [CrossRef]
- 23. Guimarães, P.; Keller, A.; Fehlmann, T.; Lammert, F.; Casper, M. Deep-learning based detection of gastric precancerous conditions. *Gut* 2020, *69*, 4–6. [CrossRef]
- 24. Song, E.M.; Park, B.; Ha, C.A.; Hwang, S.W.; Park, S.H.; Yang, D.H.; Kim, N.; Byeon, J.S. Endoscopic diagnosis and treatment planning for colorectal polyps using a deep-learning model. *Sci. Rep.* **2020**, *10*, 30. [CrossRef]
- Danis, N.; Bor, S. Effect of advanced diagnosis modalities and disease phenotypes on PPI response of gastroesophageal reflux disease. *Neurogastroenterol. Motil.* 2018, 30. Available online: https://gcris.ege.edu.tr/handle/11454/30156 (accessed on 21 April 2023).
- 26. Hançerlioğlu, S.; Yıldırım, Y.; Bor, S. Validity and reliability of the Quality of Life in Reflux and Dyspepsia (QoLRAD) questionnaire in patients with gastroesophageal reflux disease for the Turkish population. *Turk. J. Gastroenterol.* **2019**, *30*, 511–516. [CrossRef]
- 27. Levine, M.E.; Albers, D.J.; Burgermaster, M.; Davidson, P.G.; Smaldone, A.M.; Mamykina, L. Behavioral-clinical phenotyping with type 2 diabetes self-monitoring data. *arXiv* 2018, arXiv:1802.08761. https://doi.org/10.48550/arXiv.1802.08761.
- Vandromme, M.; Jun, T.; Perumalswami, P.; Dudley, J.T.; Branch, A.; Li, L. Automated phenotyping of patients with non-alcoholic fatty liver disease reveals clinically relevant disease subtypes. In Proceedings of the Pacific Symposium Biocomputing, Kohala Coast, HI, USA, 3–7 January 2020; pp. 91–102. [CrossRef]
- 29. Kahrilas, P.J.; Bredenoord, A.J.; Fox, M.; Gyawali, C.P.; Roman, S.; Smout, A.J.; Pandolfino, J.E. International High Resolution Manometry Working Group. *Chic. Classif. Esophageal Motil. Disord. Neurogastroenterol. Motil.* **2015**, *27*, 160–174. [CrossRef]
- Ge, Z.; Wang, B.; Chang, J.; Yu, Z.; Zhou, Z.; Zhang, J.; Duan, Z. Using deep learning and explainable artificial intelligence to assess the severity of gastroesophageal reflux disease according to the Los Angeles Classification System. *Scand. J. Gastroenterol.* 2023, 1–9. [CrossRef]
- Wong, M.W.; Liu, M.X.; Lei, W.Y.; Liu, T.T.; Yi, C.H.; Hung, J.S.; Liang, S.W.; Lin L.; Tseng, C.W.; Wang, J.H.; et al. Artificial intelligence facilitates measuring reflux episodes and postreflux swallow-induced peristaltic wave index from impedance-pH studies in patients with reflux disease. *Neurogastroenterol. Motil.* 2023, 35, e14506. [CrossRef]
- 32. Emile, S.H.; Ghareeb, W.; Elfeki, H.; El Sorogy, M.; Fouad, A.; Elrefai, M. Development and validation of an artificial intelligencebased model to predict gastroesophageal reflux disease after sleeve gastrectomy. *Obes. Surg.* **2022**, *32*, 2537–2547. [CrossRef]

**Disclaimer/Publisher's Note:** The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.