

# Contents

**Preface — V**

**Foreword — VII**

## **Chapter 1**

### **Cardiovascular disease diagnosis using AI-based imaging — 1**

1.1	Introduction — 1
1.2	AI: general medical applications — 2
1.3	Introduction to artificial intelligence — 2
1.3.1	Machine learning — 3
1.3.2	Deep learning — 4
1.4	Electronic health: mobile health and IoT — 5
1.4.1	Mobile health — 5
1.4.2	Internet of Things — 5
1.5	AI-based general application in CVD — 6
1.5.1	Precision medicine — 6
1.5.2	Clinical predictions — 6
1.5.3	Intelligent robots — 6
1.6	Other medical applications of AI in CVD — 7
1.6.1	Cardiovascular imaging — 7
1.6.2	Echocardiography — 8
1.6.3	Magnetic resonance imaging — 9
1.6.4	Cardiac computed tomography — 9
1.6.5	Electrocardiography — 10
1.6.6	Nuclear cardiology — 10
1.6.7	Angiography imaging — 11
1.6.8	Intravascular imaging — 11
1.7	AI-based wearables in cardiovascular care — 12
1.7.1	Heart rate and rhythm sensors — 12
1.7.2	Monitoring for hypertension — 13
1.7.3	Monitoring of atrial fibrillation and other arrhythmias — 15
1.7.4	Monitoring of heart failure — 15
1.8	AI and data management — 16
1.9	Conclusion — 17
	References — 17

## **Chapter 2**

### **Integration of AI in the management of bone health — 23**

2.1	Introduction — 23
2.2	Applications of AI in medical imaging — 25



2.3	Application of AI in orthopedics —	25
2.3.1	Natural language processing (NLP) —	25
2.3.2	Clinical prediction rule —	26
2.3.3	Outcome calculator —	26
2.4	Workflow of ML in orthopedics —	28
2.4.1	Predictive modeling: development of an ML algorithm —	28
2.4.2	External validation —	30
2.4.3	Evaluation and implementation —	31
2.4.4	Improvement of the algorithm: continuous self-learning —	32
2.5	Role of AI in bone fracture detection —	32
2.5.1	Data preprocessing —	33
2.5.2	Bone fracture —	33
2.5.3	Computer vision for fracture recognition —	34
2.6	Different techniques of AI in bone fracture detection —	35
2.6.1	Primary machine learning-based algorithm —	35
2.6.2	Ensemble-based classification system —	36
2.6.3	Deep learning —	37
2.7	Value of deep learning in radiology/orthopedic traumatology —	40
2.7.1	Combining deep learning with a radiomics approach —	41
2.8	Role of AI in bone cancer —	41
2.8.1	AI in bone cancer detection —	43
2.9	Methods for the detection of cancer —	44
2.9.1	Steps of cancer diagnosis in medical imaging —	44
2.9.1.1	Image acquisition methods —	44
2.9.1.2	Preprocessing —	44
2.9.1.3	Segmentation —	45
2.9.1.4	Feature detection —	45
2.9.1.5	Classification —	45
2.9.1.6	Image visualization —	46
2.10	Conclusion —	46
	References —	46

## **Chapter 3**

### **AI for remote patient monitoring in healthcare — 53**

3.1	Introduction —	53
3.2	Introduction to remote patient monitoring —	55
3.3	Improving therapeutic outcomes via RPM —	56
3.4	Remote patient monitoring architectures —	57
3.4.1	Video-based monitoring —	58
3.4.2	IoT-enabled devices —	59
3.4.3	Cloud computing —	60
3.4.4	Fog and edge computing —	60



3.4.5	Blockchain monitoring —	61
3.5	Application of artificial intelligence in RPM —	62
3.5.1	Sensors, smartphones, apps, and devices for RPM —	62
3.5.2	Clinical decision support-based RPM —	64
3.6	Others applications of AI in RPM —	66
3.6.1	Monitoring of vital signs —	66
3.6.2	Physical activities monitoring —	68
3.7	AI-based RPM for chronic disease monitoring —	69
3.7.1	Diabetes monitoring —	69
3.7.2	Cardiac monitoring —	70
3.7.3	“Big data” for predictive analysis —	71
3.7.4	Mental health monitoring —	72
3.7.5	Dementia monitoring —	73
3.7.6	Migraine monitoring —	75
3.7.7	Monitoring in emergency department —	76
3.7.8	Monitoring in the ICU —	77
3.7.9	Facial and emotional recognition —	78
3.7.10	Role in early detection of patient deterioration —	78
3.7.11	Personalized monitoring for patient —	80
3.8	Conclusion —	81
	References —	81

## **Chapter 4**

### **Engaging AI in emergency medicine for better patient care — 91**

4.1	Introduction —	91
4.2	What is AI? —	92
4.3	Difference between ML and DL —	94
4.4	Machine learning algorithms in clinical research —	94
4.5	Role of AI in emergency medicine —	96
4.5.1	Role in triage and disposition —	96
4.5.2	Role in ED operations —	96
4.5.3	Role in emergency department operations and management —	97
4.5.4	Role in medical imaging —	98
4.5.5	Role in clinical image analysis —	98
4.5.6	Role in predictive modeling —	98
4.5.7	Role in clinical monitoring —	100
4.5.8	Role in patient monitoring —	100
4.5.9	Role in home monitoring of patient —	101
4.5.10	Role in causal inference, risk, prediction, and metrics —	101
4.6	Conclusion —	102
	References —	103



**Chapter 5**

**Application of AI in ENT (otorhinolaryngology) care — 109**

- 5.1 Introduction — 109
- 5.2 Machine learning and deep learning — 110
- 5.3 Role of AI in audiology — 111
- 5.4 Role of AI in otology — 113
- 5.5 AI-based surgical and training applications in otology — 113
- 5.6 Role of AI in rhinology — 114
- 5.7 Role of AI in laryngology — 114
- 5.8 Role of AI in head-and-neck oncology — 115
- 5.9 Role of AI in augmenting tele-otoscopy — 117
- 5.10 Operation-based use of otoscopes in the telehealth setting — 119
  - 5.10.1 Guardian-operated — 119
  - 5.10.2 Healthcare-provider-operated — 120
- 5.11 Conclusion — 121
- References — 122

**Chapter 6**

**Integration of AI in brain tumor surgery — 125**

- 6.1 Introduction — 125
- 6.2 General applications of AI in surgery — 127
  - 6.2.1 Automated identification of surgical phases — 127
  - 6.2.2 Automated identification of instruments — 129
- 6.3 Role of AI in brain tumor surgery — 130
  - 6.3.1 Preoperative phase — 131
    - 6.3.1.1 Screening and diagnosis — 131
    - 6.3.1.2 Planning — 133
  - 6.3.2 Intraoperative phase — 135
    - 6.3.2.1 Tumor tissue identification — 135
    - 6.3.2.2 Workflow — 136
  - 6.3.3 Postoperative phase — 138
    - 6.3.3.1 Inpatient and acute care — 138
    - 6.3.3.2 Outpatient and oncological care — 139
- 6.4 Conclusion — 141
- References — 142

**Chapter 7**

**AI in dentistry: role and application — 155**

- 7.1 Introduction — 155
- 7.2 AI in dentistry — 156
- 7.3 AI in operative dentistry — 156
- 7.4 AI in periodontics — 157



7.5	AI in orthodontics — 158
7.6	AI in oral and maxillofacial pathology — 159
7.7	AI in prosthodontics — 161
7.8	AI in endodontics — 162
7.8.1	Periapical lesions detection — 162
7.8.2	Root fracture detection — 163
7.8.3	Determination of working length — 164
7.8.4	Morphology of root and root canal system — 164
7.8.5	Retreatment predictions — 165
7.8.6	Prediction of the viability of stem cells — 165
7.9	Other dental applications of AI — 166
7.9.1	In dental education — 166
7.9.2	For patient management — 166
7.9.3	For diagnosis, treatment, and prognosis — 167
7.9.4	In dental radiology — 167
7.9.5	In prosthetic dentistry — 167
7.9.6	In forensic odontology — 168
7.9.7	Applications in orthognathic surgery — 168
7.10	Application in maxillofacial imagery — 170
7.10.1	Acquisition — 170
7.10.2	Interpretation — 170
7.10.3	Treatment planning — 171
7.10.4	Custom orthodontic and surgical appliances — 171
7.10.5	Treatment follow-up — 172
7.11	Conclusion — 173
	References — 173

## Chapter 8

### Managing OPD with AI: implementation and utilization — 181

8.1	Introduction — 181
8.2	What is AI? — 183
8.3	Incorporation of AI in healthcare delivery — 183
8.3.1	Healthcare administration — 183
8.3.2	Clinical decision support system (CDSS) — 184
8.3.3	Patient monitoring — 185
8.3.4	Healthcare interventions — 186
8.4	Application of artificial intelligence for patients — 187
8.4.1	AI in predicting patient flow — 188
8.4.2	Patient flow prediction models — 189
8.4.3	AI for improving operational efficiency — 190
8.5	Modern technologies and frameworks in smart healthcare systems — 191



8.5.1	Internet of things-based smart healthcare systems —	<b>192</b>
8.5.2	Artificial intelligence in smart healthcare systems —	<b>193</b>
8.5.3	Blockchain-enabled healthcare systems —	<b>195</b>
8.5.4	Cloud computing technology for healthcare —	<b>196</b>
8.6	Conclusion —	<b>197</b>
	References —	<b>198</b>

## **Chapter 9**

### **Elder patient care and monitoring through AI — 203**

9.1	Introduction —	<b>203</b>
9.2	Introduction to artificial intelligence —	<b>204</b>
9.3	AI for care of older people —	<b>204</b>
9.4	AI based monitoring for older adults —	<b>207</b>
9.5	Using AI to improve patient care and health outcomes —	<b>209</b>
9.6	IoT and IoT-based technologies —	<b>210</b>
9.6.1	Activity recognition —	<b>211</b>
9.6.2	Wearable systems —	<b>213</b>
9.7	Incorporating robots for elder care —	<b>214</b>
9.7.1	Solutions for physical and functional challenges —	<b>214</b>
9.7.2	Solutions for cognitive challenges —	<b>215</b>
9.8	Other applications of AI in healthcare management of elderly people —	<b>216</b>
9.8.1	IoT for data acquisition —	<b>216</b>
9.8.2	Medication and healthcare assistance robots —	<b>218</b>
9.8.3	Robotics for psychological issues —	<b>219</b>
9.9	Conclusion —	<b>220</b>
	References —	<b>221</b>

## **Chapter 10**

### **AI and pregnancy: an unexpected alliance — 227**

10.1	Introduction —	<b>227</b>
10.2	AI and pregnancy —	<b>229</b>
10.3	Utilization of AI to understand maternal and fetal health —	<b>231</b>
10.3.1	Assisted reproductive technologies —	<b>231</b>
10.3.2	Developmental toxicology —	<b>233</b>
10.4	AI-based chronic disease management in pregnancy —	<b>234</b>
10.5	Pregnancy-induced disease —	<b>234</b>
10.5.1	Disease screening —	<b>235</b>
10.5.2	Disease management with clinical decision support systems —	<b>237</b>
10.6	Labor analgesia —	<b>238</b>
10.7	Mode of delivery —	<b>238</b>
10.7.1	Predict postpartum disease —	<b>239</b>



10.8	Pharmacologics and pregnancy —	239
10.9	Conclusion —	241
	References —	241

## **Chapter 11**

### **Implementation of AI in pathology — 247**

11.1	Introduction —	247
11.2	AI and digital image analysis —	251
11.3	AI to support routine pathological diagnosis —	253
11.4	Applications of AI in pathology: the current perspective —	254
11.4.1	Improve workflow efficacy —	254
11.4.2	Consistency of assessments —	255
11.4.3	IHC analysis —	256
11.4.4	Improving accuracy in cell counting —	256
11.5	Other applications of AI in pathology —	257
11.5.1	AI-assisted image analysis for prognosis prediction —	257
11.5.2	AI-based analysis of genetic data —	258
11.5.3	Integration of histomorphological, molecular pathological, and oncological data —	258
11.6	Incorporation of AI-based digital pathology —	259
11.7	Digital pathology and computer-aided pathology —	259
11.8	Application of digital pathology —	260
11.9	Using a digital pathology system in a clinical setting —	261
11.10	Conclusion —	262
	References —	263

### **Index — 269**