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The 2024 Saudi Pharmacotherapy Didactic Curriculum Toolkit: A Modified Delphi Study

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Abstract

Background Several pharmacy schools in Saudi Arabia (S.A.) refer to the American College of Clinical Pharmacy (ACCP) pharmacotherapy toolkit in developing their pharmacotherapy curriculum. However, the ACCP toolkit does not specifically address the healthcare needs of the Saudi population. A tailored pharmacotherapy curriculum that offers graduates the essential competencies to better serve the nation's needs is warranted. This study aims to develop a population-centered didactic pharmacotherapy toolkit for the Saudi population to assist pharmacy schools in designing pharmacotherapy course content.

Methods This study employed a modified Delphi method to achieve consensus among expert pharmacists on prioritizing the tiers of the 2019 ACCP Pharmacotherapy Didactic Curriculum toolkit. A questionnaire was distributed over three rounds to gather input. Following the Delphi rounds, subject matter experts from professional organizations reviewed sections of the developed toolkit and assessed the consensus tiers and unresolved topics. The research steering group then proposed additional amendments based on the latest edition of the ACCP toolkit, released in 2024. The results were analyzed using descriptive statistics.

Results Fifty-six panel members participated in the first Delphi round. After three rounds, the panel reached a consensus on 234 of the 300 topics. The consensus on the remaining 57 topics was achieved through the Pharmacy Specialty Network groups and the Saudi Oncology Pharmacy Assembly. The finalized Saudi toolkit included 234 topics (tier 1 = 86, tier 2 = 86, tier 3 = 62). The toolkit aligned with the tier ranking of 184 topics of the ACCP 2023 edition; however, 50 topic tiers were changed, either escalated (26), de-escalated (17), removed (3), or retained (5). Additionally, two new topics—"Mass Gathering Medicine" and "Other Infections (e.g., brucellosis and dengue fever)"—were added to the infectious diseases section.

Conclusion This study introduces Saudi Arabia's first Pharmacotherapy Didactic Curriculum toolkit, providing standardized, culturally relevant resources for pharmacy education nationwide. Future revisions of this toolkit are anticipated to incorporate emerging practices and educator feedback, ensuring its continued relevance and effectiveness. The Saudi Society of Clinical Pharmacy and the Saudi Oncology Pharmacy Assembly endorse and support the toolkit.

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Introduction

The design of the didactic curriculum for a Doctor of Pharmacy (Pharm.D.) program should equip graduates with the essential competencies to enter the practice and function as a member of the healthcare team. The Accreditation Council of Pharmacy Education (ACPE) identified the essential foundational sciences that are the building blocks of any Pharm.D. program, including basic biomedical sciences, pharmaceutical sciences, social / behavioral /administrative pharmacy sciences, and clinical sciences [1]. The Pharm.D. curricula include specific coursework incorporating these foundational sciences with the experiential education component. Pharmacotherapy is a core course within clinical sciences foundation courses designed to develop students' knowledge and skills in the rational use of medications that are safe, evidence-based, and economically sound [2]. To achieve such competencies, the didactic pharmacy curriculum for an entry-level degree should encompass sufficient knowledge of pharmacotherapy for the most common diseases affecting society [3, 4]. Pharmacotherapy coursework should be customized to incorporate the impact of disease demographics on society, medical sciences, and technology advancements and the subsequent expansion in drug armamentarium and drug-delivery systems.

In 2009, the American College of Clinical Pharmacy (ACCP) published its first Pharmacotherapy Didactic Curriculum toolkit (ACCP toolkit) to guide pharmacy schools on curricular content related to pharmacotherapy for disease states [4]. This initial toolkit was developed based on the consensus of the ACCP Educational Affairs Committee's topic [4]. The ACCP originally scheduled updates to this toolkit every three years, releasing updates in 2016 and 2019. However, the most recent update was released in 2023, four years after the last update [5–7]. The toolkit categorizes the topics based on disease prevalence, medications used to treat disease, and the pharmacist's role in the patient's disease management [4]. The toolkit initially arranged topics covering each disease state into three tiers focused on topic coverage, then switched to competency-based tiers in the 2016 version [4, 5]. Since the ACCP toolkit was published, many pharmacy schools in the United States (U.S.) have adjusted their pharmacotherapy didactic curricula to be aligned with the ACCP toolkit [8–10]. However, the ACCP toolkit reflects the disease prevalence, pharmacy practice, and education context in the U.S [8–10].

Since disease prevalence varies globally, the applicability of the ACCP toolkit in schools outside the U.S., including Saudi Arabia (S.A.), could be limited. Any country, including S.A., has its unique disease burden that threatens its nation's health. The increasing disease burden in S.A. is influenced by its population genomics and lifestyles, such as physical inactivity and an unhealthy diet, leading to a high obesity rate [11]. With a closer look at S.A., non-communicable diseases (NCD) are the leading cause of death, followed by injuries, then communicable diseases [12]. Cardiovascular disease (CVD) is the most common NCD, accounting for 28% of deaths, followed by cancer, diabetes mellitus, and chronic respiratory diseases [11].

The National Health Sector Transformation Program (HSTP) within the S.A. Vision 2030 strategic plan aims to strengthen NCD and injury prevention, thereby reducing avoidable illness and deaths [13]. Thus, the HSTP highlighted the need to properly train healthcare professionals to manage chronic diseases such as diabetes, cancer, and heart disease [13]. Moreover, the risk of infectious disease (ID) outbreaks remains high due to mass gatherings from various countries at holy religious sites, especially during the Hajj season [14]. An example of a significant difference in disease burden between the U.S. and Saudi Arabia is the cancer epidemiology. While breast cancer remains the most common cancer in both countries [15–17], colorectal cancer is the leading cause of cancer-related deaths in S.A., unlike in the U.S., where lung cancer is the primary cause [15, 16].

Several pharmacy schools in S.A. have adopted the ACCP toolkit to guide the selection of disease states for teaching and training pharmacy students in pharmacotherapy. Thus, there is a need to develop a population-specific didactic pharmacotherapy curriculum that equips graduates with the essential competencies to better serve our nation's needs. This study aims to develop a population-centered didactic pharmacotherapy toolkit for the Saudi population to assist pharmacy schools in designing pharmacotherapy course content. The toolkit will help provide pharmacy graduates and post-graduates with a comprehensive education in disease states relevant to the Saudi community.

Methods

Study design

This study employed a modified Delphi method to gather opinions from practicing pharmacists in an iterative and structured manner. A questionnaire was developed to achieve consensus through three rounds, prioritizing the tiers of didactic pharmacotherapy topics. A consensus level of 70% or above was predetermined for each topic, disease, or condition from the list provided to the participants in the questionnaire [18]. In rounds 2 and 3, a consensus from the previous round was presented at the

beginning of the survey. Following the three rounds of the Delphi, the list of topics was also shared with subject matter experts (SMEs) from professional organizations. The final step involved a consensus meeting among the research steering committee members to finalize the toolkit.

Expert panel participants

The Delphi expert panel was selected to ensure homogeneity and level of expertise based on the following criteria: (1) had a Pharm.D. degree, (2) completed a master's degree in clinical pharmacy, or completed a post-graduate year-1 (PGY1) and/or post-graduate year-2 (PGY2) training, (3) registered under the Saudi Commission for Health Specialties (SCFHS) as senior or consultant clinical pharmacist whose practice sites involve patient encounters (directly or indirectly) and (4) had a minimum of two years of practice experience. The participants were selected to represent the different regions of S.A. Using a convenient sampling method, the participants were identified through professional networks and personal contacts to achieve a mix of a range of locations and specialties. Individuals who met the criteria were contacted via email and received reminders through text messages. For the panel size, we targeted at least 30 participants in each round.

Questionnaire design

The newly developed questionnaire was pilot-tested with five participants outside the research setting to ensure content and face validity. The questionnaire also presented a list of queries related to the design, layout, clarity of information, and content of the questionnaire to the pilot study group. The result of the pilot participants was not included in the final results of this study.

The refined questionnaire included, in its first part, demographic information (age, education, gender, region, specialty, place of employment, and years of experience). The second part included the initial list of key pharmacotherapy topics and conditions obtained from the 2019 ACCP toolkit [6]. The panel members were asked to select the tier for each topic from the provided list, according to the tier definitions in the 2019 ACCP toolkit [6].

Delphi rounds

The questionnaire was built in the SurveyMonkey platform, and the link was emailed to participants, along with detailed instructions on the questionnaire's purpose and tier definitions. In each round, topics that reached a consensus level of 70% or above were removed from the list for the next round, but the results were shared at the beginning of the survey.

Subject matter expert (SME) from professional organizations consensus

After completing three Delphi rounds, the first draft of the toolkit was developed. This draft included tiers for topics that reached consensus and a list of topics that did not achieve consensus in any round. The relevant sections of the toolkit, organized by organ systems, were shared with SMEs from professional organizations for their review and feedback on the established tiers and unresolved topics. These SMEs are specialized clinical pharmacists representing various Pharmacy Specialty Networks (PSNs) under the Saudi Society of Clinical Pharmacy (SSCP), including Cardiology, Adult Internal Medicine (IM), Ambulatory Care, Critical Care/Emergency Medicine (EM), Pediatrics, and ID. Additionally, board members of the Saudi Oncology Pharmacy Assembly (SOPA) were also consulted. The PSNs and SOPA groups were tasked with reviewing each topic tier within their specialty according to the tier definition of the 2019 ACCP toolkit [6]. They needed to reach a consensus on topics that had not received a consensus in round 3. Additionally, they were asked to document and justify their agreement or disagreement regarding the tier selection of the Delphi group based on several factors. These factors include the number of patients they manage annually for each condition, the presence of these topics in pharmacotherapy textbooks, their relevance to common conditions covered in the Clinical Pharmacy Diploma Curriculum by the SCFHS, the level of pharmacist involvement in medication therapy for these diseases, and how these topics align with the HSTP and the goals of Saudi Vision 2023 to empower the workforce [13]. Each SME group's consensus was collected through a brief questionnaire that included a limited number of topics relevant to each specialty group, along with the tier consensus results from the Delphi rounds, when available. The IM PSN reviewed the tiers for topics related to the following organ systems: gynecologic and obstetrical conditions, gastrointestinal (GI) disorders, hematology, immunology, musculoskeletal and connective tissue disorders, neurology, urology, and renal disorders. The Ambulatory Care PSN focused on topics related to dermatology, ear, nose, and throat; endocrine disorders; ophthalmology; psychiatry; geriatrics; and respiratory conditions. The Critical Care and ED PSN reviewed conditions related to critically ill and terminally ill patients, as well as toxicologic conditions. The Pediatric PSN examined conditions specific to pediatric patients. The ID PSN provided input on ID and related conditions, while the Parenteral Therapy PSN looked into consensus on nutritional conditions. Finally, the SOPA board members reviewed oncologic conditions.

Finalizing toolkit content

Following the SMEs' revisions, the ACCP published the updated 2023 ACCP Pharmacotherapy Didactic Curriculum toolkit in March 2024 [7]. In response, the research steering team—composed of an internal medicine clinical pharmacist, a cardiology clinical pharmacist, two ambulatory care clinical pharmacists, an oncology clinical pharmacist, and a pharmacy education expert—reevaluated the tiers in May 2024. The goal was to propose further amendments based on updates from the 2023 ACCP toolkit, the expert panel consensus from the Delphi rounds, and the SMEs' tier recommendations [7]. The team decided to remove, combine, or re-title topics, considering the changes in the updated 2023 ACCP tier definitions, as shown in Fig. 1.

The changes in the 2023 ACCP toolkit tier definitions guided the research steering team to better differentiate between tier 1 and tier 2 topics, as this distinction was not very clear in the 2019 ACCP toolkit. Table S1 compares the tier definitions used in both the 2019 and 2023 ACCP toolkits [6, 7]. The final version of the toolkit was completed and approved in May 2024.

Ethical approval was obtained from the Institutional Review Board (IRB) of Princess Nourah Bint Abdulrahman University (IRB number-HAP-01-R-059). The study was conducted in accordance with the principles outlined in the 1964 Declaration of Helsinki.

Participants' responses and opinions were not anonymous to the researchers but anonymous to other participants. Participants were allocated a unique code that the researcher could only identify. Quasi-anonymity was ensured by maintaining the confidentiality of individuals' opinions and by omitting any identifying features, such as names and job titles, from the final report. The information sheet provided details about the study, and any information they provided was confidential; the anonymity of their responses was also assured. All the experts agreed to share their names in the final paper manuscript.

Data collection and statistical analysis

Descriptive statistics were used to present the results in numerical and percentage formats. Statistical summaries were performed using Excel for Microsoft 365.

Results

Among the 78 panel members contacted to participate in round 1, only 56 (72%) completed the questionnaire in the first round. 54% of the panel members were females, and most (57%) were from the central region. The demographics of the panel members are detailed in Table 1. Fifty-four panel members (97%) responded in the second round, and 53 (95%) participated in the third round, as shown in Fig. 2.

Delphi panel consensus

The three Delphi rounds were conducted on the 2019 ACCP toolkit list of topics. Among these 300 topics (without including gender-affirming therapy) shared in the list, the Delphi panelists reached a consensus level of 70% or above on 123 topics (41%) in round 1. In round 2, an additional 72 topics (24%) achieved a consensus, and 49 topics (16%) in round 3 (Fig. 2). Of the 243 topics that reached consensus, 193 were in tier 1, 21 in tier 2, and 29 in tier 3. However, 56 topics remained without consensus after the third round.

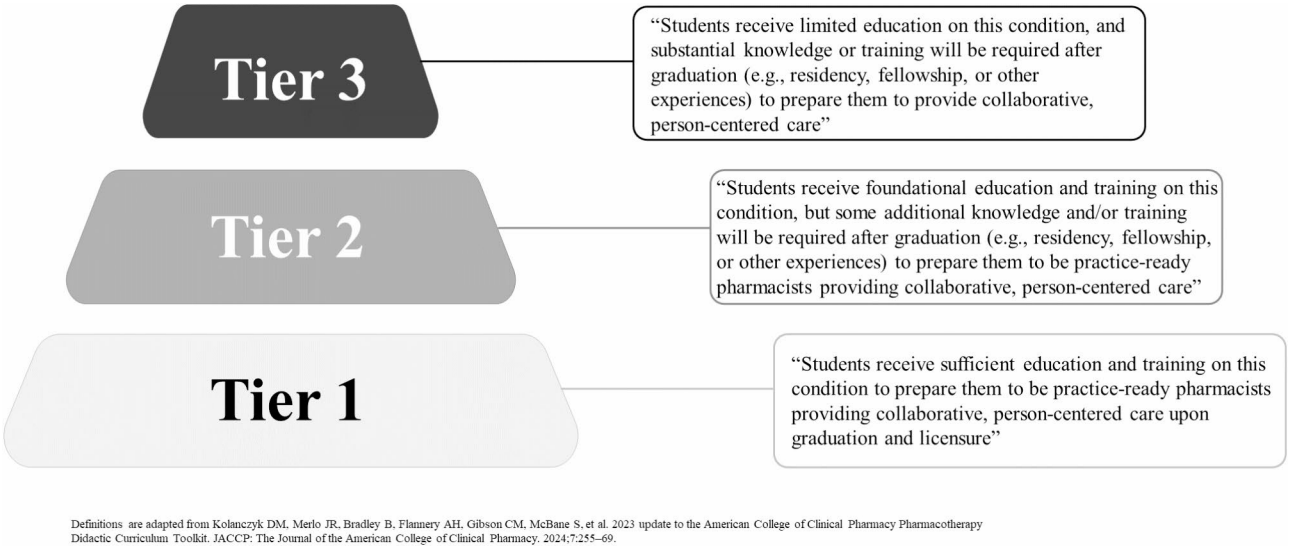

Fig. 1 The definition of tiers used for the Saudi pharmacotherapy didactic toolkit

Table 1 Demographic profile of expert panel members participated in the Delphi questionnaire

Panel members	*N* = 56
Sex	
Female	30 (53.5)
Male	26 (46.43)
Geographical Location	
Central	32 (57.14)
Western	14 (25)
Eastern	9 (16.07)
Southern	1 (1.79)
Northern	0 (0)
Additional Degree(s)/ Training (Post-Bachelor)	
Post Bachelor Pharm.D.	16 (30.19)
PGY1	34 (64.15)
Master's degree	11 (20.75)
PGY2	41 (77.36)
Fellowship	9 (16.98)
Others	5 (9.43)
Earned Board Certification	
Pharmacotherapy	27 (48.2)
Ambulatory Care Pharmacy	7 (12.50)
Critical Care Pharmacy	7 (12.50)
Cardiology Pharmacy	6 (10.71)
Infectious Diseases Pharmacy	4 (7.14)
Oncology Pharmacy	4 (7.14)
Medication Therapy Management	4 (7.14)
Pediatric Pharmacy	3 (5.36)
Solid Organ Transplantation Pharmacy	2 (3.57)
Nutrition Support Pharmacy	1 (1.79)
Others	6 (10.71)
Years of Experience	
1–5 years	12 (21.43)
6–10 years	25 (44.64)
11–15 years	12 (21.43)
16–20 years	6 (10.71)
21 years or more	1 (1.79)
Affiliated Institution	
Governmental	39 (69.64)
Military	11 (19.64)
Private	4 (7.14)
Governmental and Private	2 (3.57)

Data is presented in numbers and (%), PGY-1: Post-graduate year 1, PGY-2: Post-graduate year 2

The SME's consensus on the tier selection

Overall, 54 SMEs participated from different pharmacy specialty groups: five members in the cardiology PSN, seven in the IM PSN, seven in the Ambulatory care PSN, five in the ID PSN, eight in the critical care and EM PSN, eight in the Pediatric PSN, and seven in the Parental nutrition PSN. In addition, seven SOPA Board members also participated. Some of the PSNs and SOPA members are already part of the panel and participated in the Delphi rounds. Moreover, the collective geographical representation in the SME groups was 65% Central, 6% Eastern, 4% Northern, 11% Southern, and 15% Western.

The SMEs concurred with the tier selection of 210 out of the 244 topics (86%) that reached consensus through the three rounds of the Delphi panel. However, they recommended the reclassification of 34 topics. Twenty-one topics were "De-escalated" from tier 1 to tier 2, three from tier 1 to tier 3, and seven from tier 2 to tier 3. Conversely, three topics—advanced cardiac life support, peripheral arterial disease, and overweight and obesity—were "Escalated" from tier 2 to tier 1. The most common reasons for tier changes were the number of cases seen per year, the level of pharmacists' involvement in medication therapy for these diseases, the level of knowledge and training required to manage such conditions, and the inclusion of these topics in textbooks. For the 56 unresolved topics from the Delphi rounds, the SMEs categorized eight as tier 1, 24 as tier 2, and 24 as tier 3. Table S2 in the supplementary file provide a detailed comparison between the 2019 ACCP toolkit, the Delphi panel consensus, the SMEs' recommendations. Figure S1 shows a summary of the tier percentages from the Delphi, SME groups, and the research steering team.

The 2024 Saudi pharmacotherapy didactic curriculum toolkit

The research steering team re-evaluated the toolkit version following SMEs' revisions against the updated ACCP 2023 toolkit, which contained 231 disease topics. The finalized first version of the 2024 Saudi pharmacotherapy toolkit contained a total of 234 topics: 86 as tier 1 (36.7%), 86 as tier 2 (36.7%), and 62 as tier 3 (26%) (Table 2). Compared to the ACCP 2023 toolkit, the developed Saudi pharmacotherapy toolkit agreed with the tier ranking of 184 disease topics (64 in tier 1, 76 in tier 2, and 44 in tier 3) (Fig. 3). Twenty-six topics had changed classification either by escalation (19 topics from tier 2 to tier 1, two topics (PCOS and coagulation disorders) from tier 3 to tier 1, and five topics (pulmonary hypertension, xerosis, pituitary gland disorders, envenomation, and obsessive-compulsive disorders) from tier 3 to tier 2. Seventeen topics were de-escalated: four from tier 1 to tier 2 (anorectal disorders, soft tissue injuries, opioid use disorder, and metabolic dysfunction-associated fatty liver disease) and 13 topics from tier 2 to tier 3 (advanced cardiac life support, arrhythmias, ventricular, cerumen impaction, Adrenal gland disorders, labor and delivery, sleep-wake disorders, gynecologic cancers, multiple myeloma, melanoma, bronchiolitis, neonatal and pediatric, critical care, respiratory support and end-of-life care and symptom management). Three topics were removed from the toolkit (gender-affirming therapy, pregnancy termination, and medical aid in dying).

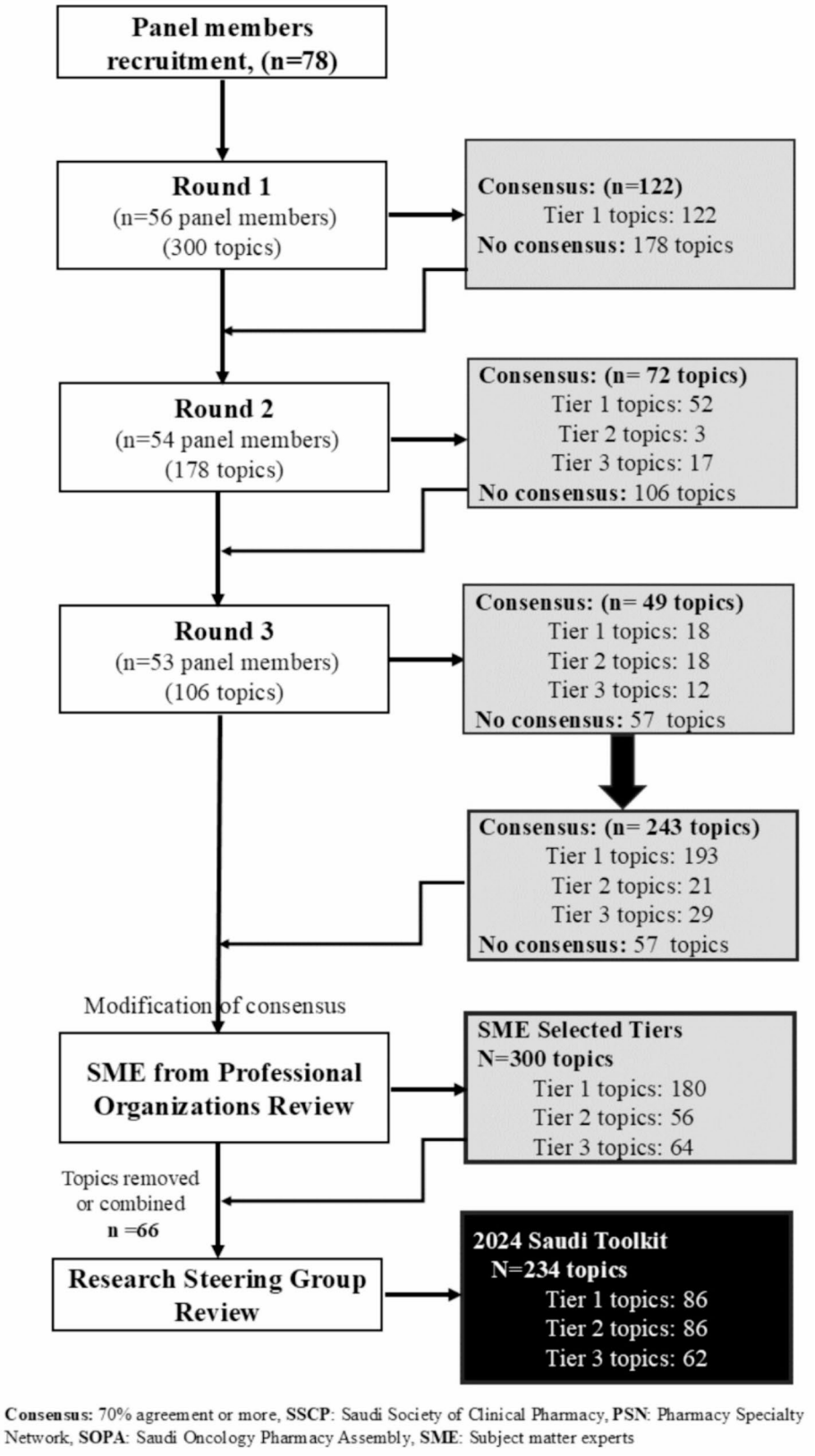

Fig. 2 The modified Delphi method process to achieve the 2024 Saudi pharmacotherapy didactic toolkit

Table 2 The 2024 Saudi pharmacotherapy didactic curriculum toolkit

Tiers	Organ systems
	Cardiovascular Conditions
1	Arrhythmias, atrial (e.g., atrial fibrillation)
1	*Chronic coronary disease (formerly stable ischemic heart disease)*
1	Dyslipidemia
1	Heart failure, chronic
1	Hypertension
1	Venous thromboembolism, prevention and treatment
2	Acute coronary syndromes
2	Heart failure, acute decompensated
2	Hypertensive crises
2	Peripheral arterial disease
2	Pulmonary hypertension
2	Stroke (ischemic, hemorrhagic, and transient ischemic attack)
2	Valvular heart diseases
3	Advanced cardiac life support
3	Arrhythmias, ventricular
3	Pericarditis
	Dermatologic Conditions
1	Acne vulgaris
1	Burn injuries, minor (e.g., sunburn, self-treated burns)
1	Dermatitis (e.g., atopic, contact, diaper)
1	Insect bites and stings, prevention and treatment
2	Alopecia
2	Psoriasis
2	Sun-induced skin disorders, prevention
2	Warts, calluses, and corns
2	Wounds, minor (e.g., lacerations, punctures, bites, incisions, abrasions, avulsions)
2	Xerosis (dry skin)
3	Stevens-Johnson syndrome, toxic epidermal necrolysis
3	Wounds, major (e.g., pressure ulcers)
	Ear, **nose**, **mouth**, **and throat conditions**
1	Allergic rhinitis
1	Common cold
1	Cough
1	Oral lesions (e.g., cold sores, aphthous ulcers)
1	Otitis externa (e.g., swimmer's ear)
2	Xerostomia (dry mouth)
3	Cerumen impaction
	Endocrine conditions
1	Diabetes, type 1 (including latent autoimmune diabetes)
1	Diabetes, type 2 (including prediabetes)
1	Hypothyroidism
1	Hyperthyroidism
2	Hyperglycemic crises
2	Male hypogonadism
2	Pituitary gland disorders
3	Adrenal gland disorders
3	*Diabetes secondary*, e.g., *monogenic diabetes syndromes*, *cystic fibrosis*, *pancreatitis*, *organ transplantation)*
	Gastrointestinal Conditions
1	Constipation
1	Diarrhea
1	*Drug dosing in hepatic dysfunction*
1	Gastroesophageal reflux disease (including heartburn)

Table 2 (continued)

Tiers	Organ systems
1	Nausea and vomiting, simple (e.g., acute viral gastroenteritis, overindulgence, motion sickness)
1	Cirrhosis, end-stage liver disease, and complications (e.g., portal hypertension, ascites, varices, hepatic encephalopathy, hepatorenal syndrome)
1	Inflammatory bowel disease (Crohn's disease, ulcerative colitis)
1	Irritable bowel syndrome
1	Peptic ulcer disease (including stress-related mucosal injury, and gastrointestinal bleeding)
2	Anorectal disorders (e.g., hemorrhoids)
2	Nausea and vomiting, complex (e.g., postoperative)
2	*Metabolic dysfunction-associated fatty liver disease*
2	Pancreatitis (acute, chronic, and drug-induced)
	Gynecologic and Obstetrical Conditions
1	Contraception (including emergency contraception)
1	*Drug safety in pregnancy and lactation*
1	Menopausal symptoms
1	Polycystic ovary syndrome
2	Diabetes mellitus, gestational
2	Hypertensive disorders of pregnancy (e.g., pregnancy-induced hypertension, preeclampsia, eclampsia)
2	Menstrual cycle disorders (e.g., dysmenorrhea, menorrhagia, premenstrual dysphoric disorder)
2	Other pregnancy-induced and chronic conditions (e.g., constipation, gastroesophageal reflux disease, nausea and vomiting, UTI)
3	Endometriosis and uterine fibroids
3	Female sexual dysfunction
3	Infertility
3	Labor and delivery (e.g., labor induction, preterm labor, pain management, postpartum hemorrhage)
2	Postpartum depression
	Hematologic conditions
1	Anemias (e.g., iron deficiency, vitamin B12 deficiency, folic acid deficiency, chronic disease/inflammation)
1	Coagulation disorders (e.g., hemophilia, von Willebrand disease, antiphospholipid syndrome, clotting factor deficiencies)
1	Sickle cell disease
2	*Heparin-induced thrombocytopenia*
2	Thalassemia
3	Aplastic anemia
3	*Drug-induced hemolytic anemias*
3	Platelet disorders (e.g., idiopathic thrombocytopenic purpura, thrombotic thrombocytopenic purpura)
	Immunologic conditions
1	Allergies/drug hypersensitivities (e.g., anaphylaxis)
1	Systemic lupus erythematosus
2	Drug desensitization (e.g., penicillin skin testing)
2	Solid organ transplantation
	Infectious diseases and conditions
1	*Clostridioides difficile* infection
1	Common parasitic diseases (e.g., head and body lice, pinworm)
1	Central nervous system (CNS) infections (e.g., meningitis, encephalitis, brain abscess)
1	Fungal infections, superficial (e.g., vulvovaginal and oral/esophageal candidiasis, dermatophytoses)
1	Hepatitis, viral
1	Immunizations (including travel vaccinations)
1	Influenza virus infection
1	Lower respiratory tract infections
1	**Other infections (Brucellosis, dengue fever)**
1	Skin and soft tissue infections
1	Upper respiratory tract infections (e.g., otitis media, sinusitis, bronchitis, pertussis)
1	Urinary tract infections, uncomplicated
1	Tuberculosis
2	Antimicrobial prophylaxis in surgery and other procedures

Table 2 (continued)

Tiers	Organ systems
2	Bloodstream and catheter infections
2	Bone and joint infections
2	Fungal infections, invasive (e.g., endemic fungus, cryptococcosis, aspergillosis, hematogenous candidiasis, mucormycosis)
2	Gastrointestinal infections (e.g., infectious diarrhea, enterotoxigenic poisonings)
2	Human immunodeficiency virus (HIV) infection (including pre-and post-exposure prophylaxis)
2	*Opportunistic infections in patients with altered immunocompetence*
2	Infective endocarditis
2	Intra-abdominal infections
2	**Mass gathering Medicine (Hajj & Umrah**, **Entertainment events**, **sports events**, **political summits…etc)**
2	Sexually transmitted infections (e.g., syphilis, gonorrhea, chlamydia, trichomoniasis, human papillomavirus, pelvic inflammatory disease)
2	Urinary tract infections, complicated
2	Viral infections (e.g., varicella, cytomegalovirus, herpes simplex, measles [rubeola], mumps, rabies)
3	Mycobacterial infections, other (leprosy, nontuberculous mycobacterial infections)
3	Prostatitis
3	Tickborne illnesses (e.g., Lyme borreliosis, ehrlichiosis, Rocky Mountain spotted fever, relapsing fever)
3	Travel medicine (including prevention and treatment)
3	Mycobacterial infections, other (leprosy, nontuberculous mycobacterial infections)
	Kidney, **fluid**, **and electrolyte conditions**
1	Chronic kidney disease, prevention of progression
1	*Drug dosing in altered kidney function (excluding dialysis)*
1	Electrolyte disorders (potassium, calcium, phosphorus, magnesium)
1	Acid-base disturbances
1	Acute kidney injury
1	Chronic kidney disease, secondary complications
2	*Drug dosing in dialysis*
1	Sodium and water disorders (including syndrome of inappropriate antidiuretic hormone, diabetes insipidus)
3	*Kidney replacement therapies*
	Musculoskeletal and connective tissue conditions
1	Gout and hyperuricemia
1	Osteoarthritis
1	Osteoporosis
1	Rheumatoid arthritis
2	Soft tissue injuries (e.g., strains, sprains, myalgias)
3	Rhabdomyolysis
	Neurologic conditions
1	Headache (e.g., tension-type, migraine, cluster)
1	Epilepsy
1	Pain, neuropathic (e.g., diabetic, postherpetic)
1	Pain, nociceptive (acute and chronic)
2	Essential tremor
2	Fibromyalgia
2	Multiple sclerosis
2	Neurocognitive disorders (e.g., Alzheimer's disease, vascular dementia, frontotemporal dementia)
2	Parkinson disease
2	Status epilepticus
3	Amyotrophic lateral sclerosis
3	Huntington disease
3	Myasthenia gravis
3	Sleep-wake disorders (e.g., narcolepsy, restless legs syndrome, circadian rhythm disorders; see also "Insomnia" in the Psychiatric and Behavioral Conditions section)
	Nutritional Conditions
1	Nutrient deficiency and excess (including vitamins and trace minerals)
1	Overweight and obesity

Table 2 (continued)

Tiers		Organ systems
2	Malabsorptive syndrome (including metabolic surgical procedures)	
2	Malnutrition prevention and treatment (e.g., enteral and parenteral nutrition)	
	Oncologic conditions	
1	Supportive care I (pain, nausea, vomiting, constipation, diarrhea, fatigue, mucositis)	
2	Breast cancer	
2	Colorectal cancer	
2	*Leukemias*, *acute and chronic*	
2	Lung cancer	
2	Lymphomas (Hodgkin's lymphoma, non-Hodgkin's lymphoma)	
2	Oncologic emergencies (e.g., tumor lysis syndrome, hypercalcemia, coagulopathy, febrile neutropenia)	
2	Prostate cancer	
2	Supportive care II (e.g., myelosuppression, thrombosis, extravasation)	
3	Bladder cancer	
3	Head and neck cancer	
3	Hematopoietic stem cell transplantation, including complications	
3	Gastrointestinal cancers, other (e.g., carcinoid, esophageal, gastric, hepatobiliary, pancreatic)	
3	Germ cell tumors	
3	*Gynecologic cancers (cervical*, *endometrial*, *ovarian)*	
3	*Multiple myeloma*	
3	Melanoma	
3	Myelodysplastic syndromes	
3	Pediatric malignancies (e.g., Ewing sarcoma, Wilms tumor, osteosarcoma, rhabdomyosarcoma)	
3	Renal cell carcinoma	
3	Skin cancer, nonmelanoma (e.g., basal cell carcinoma, cutaneous squamous cell carcinoma)	
	Ophthalmic conditions	
1	Conjunctivitis (e.g., bacterial, viral, allergic)	
1	Keratoconjunctivitis sicca (dry eye syndrome)	
2	Glaucoma	
3	Bacterial keratitis	
3	Blepharitis	
3	Corneal abrasions	
3	Hordeolum (stye)	
3	Macular degeneration	
3	**Retinopathy**	
	Psychiatric and behavioral conditions	
1	Anxiety disorders (e.g., generalized anxiety, panic, social anxiety disorder)	
1	Depressive disorders (e.g., major depressive disorder)	
1	Insomnia (see other sleep–wake disorders in the Neurologic Conditions section)	
1	Tobacco/nicotine use disorder (including smoking cessation)	
2	Alcohol use disorder (including alcohol withdrawal)	
2	Opioid use disorder (including opioid withdrawal)	
2	Attention-deficit/hyperactivity disorder	
2	Bipolar disorder (e.g., mania, bipolar depression, maintenance therapy)	
2	Delirium/acute agitation (non-critically ill patients)	
2	Obsessive-compulsive disorders	
2	Schizophrenia	
2	Trauma- and stressor-related disorders (e.g., posttraumatic stress disorder)	
3	Eating disorders (e.g., anorexia nervosa, bulimia nervosa, binge eating disorder)	
3	Substance use disorders, other (e.g., hallucinogens, stimulants, depressants, performance-enhancing drugs)	
3	Autism spectrum disorders	
	Respiratory conditions	
1	Asthma	
1	Chronic obstructive pulmonary disease	

Table 2 (continued)

Tiers		Organ systems
2	Cystic fibrosis	
2	Obstructive sleep apnea	
	Urologic conditions	
1	Benign prostatic hyperplasia (BPH)	
1	Erectile dysfunction	
1	Urinary incontinence (including overactive bladder)	
Tiers	**Conditions for Special Populations**	
	Pediatrics	
1	Dehydration and oral replacement therapy	
1	Fever	
1	Pediatric drug dosing	
1	*Pain relief*	
3	Bronchiolitis (including respiratory syncytial virus [RSV])	
3	Congenital heart disease (including patent ductus arteriosus)	
3	Enuresis	
3	Neonatal and pediatric critical care (e.g., apnea of prematurity, bronchopulmonary dysplasia, sepsis, respiratory distress syndrome)	
3	Nutrient deficiency and excess in infants and children	
3	Pediatric advanced life support	
	Older people	
1	*Safe medication use in older people (e.g., tools for improving medication safety [AGS Beers, STOPP/START, STEADI-Rx], drug dosing and monitoring, PIMs, deprescribing)*	
	Critically ill	
2	Acute respiratory distress syndrome	
2	CNS trauma	
2	Pain, agitation, and delirium	
2	Sepsis	
2	Shock syndromes	
3	Burns, major/severe	
3	Extracorporeal membrane oxygenation (ECMO), pharmacologic considerations	
3	Mechanical circulatory support devices, pharmacologic considerations	
3	Post-intensive care syndrome	
3	Respiratory support (including rapid sequence intubation)	
3	Subarachnoid hemorrhage, aneurysmal	
	Terminally ill	
3	End-of-life care and symptom management	
	Toxicologic conditions	
1	Acetaminophen toxicity	
1	Opioid overdose	
2	Anticoagulation overdose and reversal	
2	Antidepressant overdose (including serotonin syndrome)	
2	Antihypertensive medication toxicity	
2	Benzodiazepine overdose	
2	Digoxin toxicity	
2	Envenomation (e.g., snakes, scorpions, spiders)	
2	*Salicylate poisoning*	
2	Sympathomimetic toxicity (e.g., cocaine, amphetamines, novel synthetic cathinone)	
2	Toxic alcohol poisoning (e.g., ethylene glycol, methanol)	
3	Cannabinoid toxicity	
3	Anticholinergic toxicity (e.g., atropine, antimuscarinic chemical weapons)	
3	Cholinergic toxicity (e.g., anticholinesterase insecticides, nerve agent chemical weapons)	

Italic: renamed topics according to the 2023 ACCP toolkit, Bold: Added topics compared to the 2023 ACCP toolkit

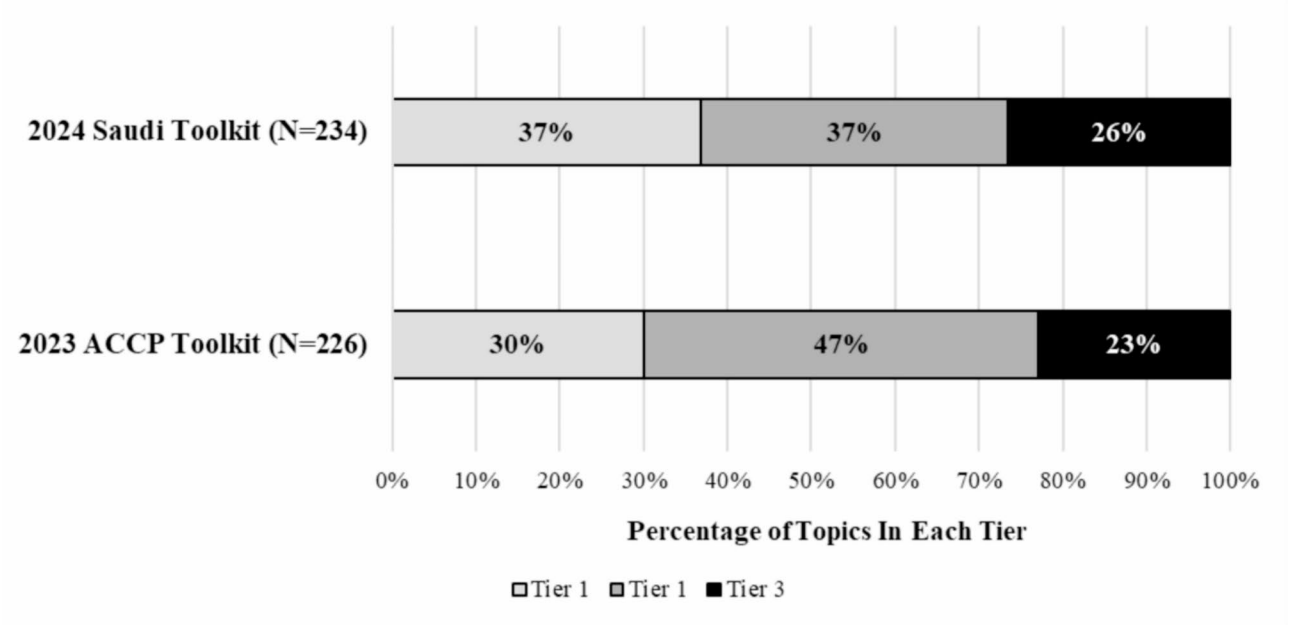

Fig. 3 Comparing the percentage of topics in each Tier of the 2023 ACCP Pharmacotherapy Curriculum Toolkit and the 2024 Saudi Pharmacotherapy Curriculum Toolkit

The 2023 ACCP toolkit also featured the removal of 77 topics; the research group disagreed with the removal of five disease conditions and kept them in the Saudi pharmacotherapy toolkit as tiers 2 (Thalassemia) or tier 3 (aplastic anemia, platelet disorders, pediatric malignancies, and autism spectrum disorders). Table S3 compares the disease topics ranked or classified in the Saudi toolkit to the 2023 ACCP version.

The 2023 ACCP toolkit also included four new topics that were not present in the 2019 ACCP toolkit, such as other pregnancy-induced and chronic conditions, coronavirus disease 2019 (COVID-19), retinopathy, and post-intensive care syndrome [7]. The Saudi toolkit accepted the introduction of these topics, except for COVID-19, which was instead considered to be embedded within respiratory infections topics. Two new topics that were not presented in the 2023 ACCP toolkit or any previous ACCP toolkit were included in the Saudi toolkit, including mass-gathering medicine and other infections (brucellosis and dengue fever).

Discussion

This study aimed to develop a pharmacotherapy curriculum toolkit to assist pharmacy colleges across the country in designing pharmacotherapy course content. The resulting Saudi toolkit included 234 disease topics deemed relevant to varying degrees for our setting. There was an agreement with the 2023 ACCP toolkit in 64 topics to be ranked as tier 1 because of their high prevalence and disease burden in our society. In S.A., NCDs account for 73.2% of deaths, with CVDs responsible for 37% [11, 12]. In addition, CVDs, diabetes, chronic respiratory diseases, and cancers are associated with 25% disability-adjusted life years [12]. The burden from behavioral and metabolic risk factors such as smoking, physical inactivity, high fasting plasma glucose, high blood pressure, elevated body mass index, and high low-density lipoprotein has increased over the past decade [19, 20]. It is expected to continue to increase rapidly in our society [19, 20].

The decision to retain five disease topics removed by the 2023 ACCP toolkit—thalassemia, aplastic anemia, platelet disorders, pediatric malignancies, and autism spectrum disorders—was driven by their significant health impact in S.A., particularly due to the high prevalence of consanguineous marriages [21, 22]. The Premarital Screening Program (PMS), mandated in S.A. and supported by 300 centers nationwide, underscores the importance of these conditions [23]. Recognizing their relevance for educational and health awareness purposes, these topics were retained and reclassified as tier 2 or 3. On the other hand, three topics were excluded from the Saudi toolkit that were not culturally or religiously applicable or acceptable in our society; these are gender-affirming therapy, pregnancy termination, and medical aid in dying.

The 2024 Saudi toolkit assigned different tier rankings for 43 topics compared to the 2023 ACCP toolkit. This escalation and de-escalation of the topics across tiers considered the difference in epidemiology, practice, and management of these conditions in our community. Among the topics that were escalated from tier 2 or 3 to tier 1 are epilepsy, rheumatoid arthritis, viral

hepatitis, sickle cell anemia, polycystic ovary syndrome, tuberculosis, cirrhosis, inflammatory bowel disease, irritable bowel syndrome, peptic ulcer disease, hyperthyroidism, diabetes, type 1 diabetes, burn injuries, minor (e.g., sunburn, self-treated burns), insect bites and stings, prevention, and treatment. These topics are commonly seen in our population. As an example, PCOS prevalence in S.A. ranged in studies from 16 to 53% among Saudi women [24]. Additionally, scorpion stings pose a significant public health challenge in S.A., with thousands of cases reported annually, averaging 4 per 1,000 population, while insect bites affect 66.6% of the population and incur substantial healthcare cost [25].

The Saudi toolkit introduced two new topics: mass gathering medicine and other infections (brucellosis and Dengue fever). These additions were made based on several important considerations. First, S.A., known for hosting the two holy mosques visited by Muslims worldwide, has established the Global Center for Mass Gatherings Medicine (GCMGM). This center serves as a global reference for mass gathering medicine and emphasizes the necessity for specialized training for healthcare professionals [25]. During the Umrah and annual Hajj pilgrimages, S.A. accommodates large numbers of people with diverse health needs, prompting the health authorities to mandate specific health requirements for all travelers [26, 27]. These requirements encompass vaccinations, assessments of physical ability and chronic diseases, and extensive educational campaigns that begin in travelers' home countries and continue throughout the religious period. Additionally, strategies are implemented to prevent respiratory and enteric infections (e.g., diarrhea) and heat-related conditions such as heat stroke, sunburn, and dehydration. Prioritizing this topic as tier 2 is crucial, as it aligns with the pharmacist's role in disease prevention, public health, as well as the cultural values of our society. Second, brucellosis and dengue fever are still health concerns in our society. The incidence rate of human brucellosis in S.A. is 12.83 per 100,000, with Brucella abortus and *Brucella melitensis* being the most common species [28]. Similarly, dengue fever has an annual incidence rate of 13.68 per 100,000 person-year [29]. Both infections are under the Ministry of Health surveillance as they remain significant health risks and crucial indicators, making their inclusion in the toolkit essential.

The Saudi Pharmacotherapy Didactic toolkit includes 234 topics, slightly more than the 231 topics in the 2023 ACCP toolkit, with nearly two-thirds classified as either tier 1 or tier 2. Although it is relatively similar to the 2023 ACCP toolkit, where more than two-thirds of the topics were either tier 1 or 2, this could present a challenge in designing the pharmacotherapy curriculum, potentially leading to overcrowding [30]. However, it is not expected that each condition in the toolkit will be covered in detail or as a separate course. To effectively implement the toolkit, strategies such as adjusting the depth of coverage, incorporating self-directed learning, and integrating related topics into combined modules can be employed. Additionally, revisiting the ACCP 2023 tier-level definitions and conducting regular feedback and content reviews will enable colleges to realign the content according to program competencies, societal needs, and advancements in pharmacy practice [31].

This study has several notable strengths. The consensus-building process, which engaged experts and professional SME groups, ensured that the toolkit reflects a balanced and comprehensive perspective tailored to the Saudi healthcare context. Additionally, the transparent and structured approach to developing and documenting the toolkit enhances accountability and credibility, making future revisions and updates more manageable. On the other hand, the study faced several limitations. First, the Delphi rounds relied heavily on the experts' subjective interpretations and personal experiences, potentially leading to varied understandings of the 2019 toolkit's tier definitions [6]. This variability may have contributed to inconsistent responses and made achieving consensus more challenging. However, the involvement of SMEs in reviewing the Delphi results helped mitigate some of these challenges and strengthened the validity of the consensus by incorporating a broader perspective from the professional community. Nonetheless, it is worth noting that most of the SMEs participating in the Delphi rounds and SMEs were from the central region. Second, the lack of updated local epidemiological data limited the ability to explore certain topics where consensus was not fully achieved thoroughly or to accurately assign the most appropriate tier. Finally, this study used the 2019 ACCP tier definitions; however, employing the updated tier definitions from the 2023 ACCP toolkit could have produced different results, although some degree of subjectivity would likely still be a factor. Future research should consider developing localized Arabic tier definitions to better reflect regional understanding and context.

Conclusion

The 2024 Saudi Pharmacotherapy Didactic Curriculum Toolkit is the first locally adapted resource for pharmacy education in S.A., representing a major step forward in standardizing pharmacotherapy education nationwide. This toolkit offers a tailored, comprehensive guide for pharmacy undergraduate curricula, residency programs, and ongoing professional development. Future revisions should focus on refining and customizing the tier definitions and updating them based on the latest disease epidemiology in S.A. to more effectively address the country's specific needs and context.

Abbreviations

ACCP	American College of Clinical Pharmacy
SSCP	Saudi Society of Clinical Pharmacy
S.A.	Saudi Arabia
U.S.	United States
Pharm.D.	Doctor of Pharmacy degree
HSTP	Health Sector Transformation Program
PGY-1	Post-graduate year-1
PGY-2	post-graduate year-2
SCFHS	Saudi Commission for Health Specialties
PSN	Pharmacy Specialty Network
SOPA	Saudi Oncology Pharmacy Assembly
CV	Cardiovascular
ID	Infectious diseases
ED	Emergency medicine
GI	Gastrointestinal
NCD	Noncommunicable diseases
HST	Health sector transformation program
SME	Subject matter experts
CVDs	Cardiovascular diseases
SCFHS	Saudi Commission for Health Specialties

Supplementary Information

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Supplementary Material 1

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Author contributions

G.B. and G.K. both contributed equally as the primary authors. G.B, G.K, S.A, N. A, A.A and L.A have participated in (a) the conception and design, analysis, and interpretation of the data; (b) drafting the article or revising it critically for important intellectual content; and (c) approval of the final version.

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Data availability

Data collected during this study is available upon request by contacting Ghazwa B. Korayem (gbkorayem@pnu.edu.sa). Materials used for the questionnaire are also available upon request.

Declarations

Ethics approval and consent to participate

This study was approved by the Institutional Review Board (IRB) of Princess Nourah bint Abdulrahman University (PNU) with IRB registration number HAP-01-R-059. Informed consent was obtained when the panel members agreed to participate in the survey.

Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used ChatGPT only to improve language and readability. They did the final review and edits of the content and took full responsibility for the publication's content.

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Conflict of interest

The authors are not affiliated with any organization that has a direct or indirect financial interest in the subject matter discussed in the manuscript.

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