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- Pharmacy Education & Practice
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- Medication Safety
- Herbal Medicines & Nutraceuticals
- Society Activities
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Embracing Transformation in Pharmacy: From Community Engagement to Artificial Intelligence

Welcome to this issue of the Hong Kong Pharmaceutical Journal, which arrives at a pivotal moment of transformation for our profession. As we look toward the future, the articles in this edition highlight a common theme: the necessity of evolution — whether through the integration of advanced technologies, the refinement of primary healthcare services, or the continuous pursuit of clinical excellence.

Our feature interview in the "Pharmacy Education & Practice" section introduces us to Ms. Anita Chan, a pharmacist who has "blazed a nontraditional trail". Her journey — from frontline patient care in the U.S. to founding the innovative Pharm+ outpatient service at St. James' Settlement and leading executive roles in the pharmaceutical industry — serves as a powerful testament to professional adaptability. Ms. Chan's leadership philosophy of being "like water" reminds us that while our settings may change, our foundational commitment to patient care remains the constant that drives our success.

The shift toward a more robust primary healthcare system in Hong Kong is further explored through a district-based survey and public forum conducted by the Sha Tin District Health Centre Express. These articles reveal critical insights into the medication management challenges faced by our citizens and the significant gap between the public's awareness of community pharmacy services and their actual needs. As the government prepares to launch the Community Pharmacy Programme, these findings underscore the urgent need for pharmacists to actively bridge this gap through enhanced public engagement and evidence-based practice.

In addition, this issue features a narrative review that delves into the evolving science of probiotics. Shifting the focus beyond localized gut health, the authors explore how these microorganisms exert systemic effects throughout the human body. This comprehensive overview equips pharmacists with a deeper understanding of the therapeutic potential and clinical applications of probiotics across a diverse range of health conditions.

In an era defined by rapid technological advancement, we also delve into the next evolution of the pharmaceutical industry: Artificial Intelligence (AI). Our exploration of Transformers and Large Language Model (LLM) agents provides a timely guide for Hong Kong pharmacists to understand how these autonomous tools can revolutionize regulatory submissions, compliance monitoring, and stakeholder communication. While AI offers unprecedented efficiency, we are reminded that human critical judgment and specialized AI literacy are non-negotiable for ensuring patient safety.

This issue also keeps our readers at the cutting edge of therapeutic developments. Our "News & Short Communications" section summarizes landmark clinical trials, including the superior outcomes of ibrutinib-venetoclax in chronic lymphocytic leukemia and the survival benefits of amivantamab-lazertinib in EGFR-mutated lung cancer.

Together, these contributions reflect a profession that is not only responding to change but actively shaping it. By blending innovative service models with cutting-edge technology and rigorous clinical evidence, we continue to elevate the role of the pharmacist as an indispensable leader in the healthcare ecosystem.

We hope this issue inspires you to remain curious, embrace new tools and stay passionate about the meaningful impact we make in the lives of our patients.

May P S Lam
Editor-in-Chief
January 2026

Prepared by Candice Leung & Branson Fok

Ibrutinib-venetoclax Demonstrates Clinical Benefits on Undetectable Measurable Residual Disease and Progressive-free Survival in Chronic Lymphocytic Leukemia

Date: September 25, 2025

Chronic lymphocytic leukemia (CLL) refers to a chronic lymphoproliferative disorder, where malignant B cells proliferate and accumulate autonomously via B-cell receptor (BCR) signalling that is mediated by Bruton's tyrosine kinase (BTK). Relevant guideline updates have suggested the use of targeted therapeutic agents over conventional chemoimmunotherapy as first-line treatment for treatment-naïve or refractory CLL. Ibrutinib, an oral BTK inhibitor, blocks BCR signalling and thus reduces CLL-cell proliferation, whereas venetoclax is an oral small-molecule BCL2 inhibitor that induces CLL-cell apoptosis.

The phase 3, multi-centre, randomized and open-label FLAIR trial had recruited a total of 786 eligible patients with untreated CLL. All participants were then randomly assigned in 1:1:1 ratio to receive (1) oral ibrutinib-venetoclax therapy (n=260), (2) oral ibrutinib monotherapy (n=263) or (3) fludarabine-cyclophosphamide-rituximab (FCR) chemoimmunotherapy every 4 weeks for 6 cycles (n=263). Oral ibrutinib was given at a dose up to 420mg daily and the ibrutinib-venetoclax group was also given venetoclax up to 400mg daily for a total of 6 years. The primary endpoints were the undetectable MRD in bone marrow within 2 years after randomization between the oral treatment groups and progression-free survival as compared with the FCR control group.

Undetectable MRD in bone marrow was documented in 66.2% of patients receiving ibrutinib-venetoclax therapy, while all participants in the ibrutinib monotherapy group failed to achieve undetectable MRD within 2 years (P<0.001). With a median follow-up of 62.2 months, disease progression or death occurred in 18 participants (6.9%) in the ibrutinib–venetoclax group, as compared with 59 (22.4%) in the ibrutinib-alone group (hazard ratio=0.29, 95% confidence interval [CI], 0.17-0.49, P<0.001) and 112 (42.6%) in the FCR group (hazard ratio=0.13, 95% confidence interval [CI], 0.08-0.21, P<0.001). No new safety concerns emerged with MRD-guided ibrutinib-venetoclax, with cardiovascular-related adverse effects remain a concern regarding ibrutinib usage.

To summarize, ibrutinib-venetoclax therapy is superior to ibrutinib monotherapy and FCR chemoimmunotherapy with clinical evidence of demonstrating undetectable MRD and extending progression-free survival among patients with chronic lymphocytic leukemia.

Source: www.nejm.org

Trastuzumab Deruxtecan plus Pertuzumab Reduces Progression of Death from HER2-Positive Metastatic Breast Cancer

Date: October 29, 2025

Trastuzumab deruxtecan (T-DXd), an antibody–drug conjugate aimed specifically at HER2, has been effective at treating previously treated HER2-positive metastatic breast cancer, prompting research in patients who are naive to therapy. Pertuzumab combined with trastuzumab and a taxane (THP) is currently an established first-line therapy for HER2-positive advanced or metastatic disease, however it has been unclear whether a T-DXd–based regimen can improve outcomes over THP.

A phase 3, randomized trial enrolled patients with HER2-positive advanced or metastatic breast cancer who had received no prior chemotherapy or HER2-directed therapy for metastatic disease. Participants were randomly assigned in a 1:1:1 ratio to receive T-DXd plus pertuzumab, T-DXd plus pertuzumab-matching placebo, or standard THP (taxane, trastuzumab, and pertuzumab). The primary endpoint was progression-free survival (PFS) by blinded independent central review, while key secondary endpoints included overall survival, objective response, duration of response, safety, and patient-reported outcomes.

At the data-cutoff (February 26, 2025), median progression-free survival was 40.7 months with T-DXd plus pertuzumab and 26.9 months with THP (hazard ratio for progression or death, 0.56; 95% CI, 0.44–0.71; P<0.00001). The confirmed response rate was 85.1% in T-DXd plus pertuzumab versus 78.6% in THP, with complete responses in 15.1% and 8.5%, and median duration of response of 39.2 versus 26.4 months, respectively. However, adjudicated drug-related interstitial lung disease or pneumonitis was more frequent with T-DXd plus pertuzumab (12.1%, including two grade 5 events) than with THP (1.0%, all grade 1–2).

In conclusion, T-DXd plus pertuzumab improves disease control compared to standard THP in HER2-positive metastatic breast cancer, however at the cost of a higher risk of ILD that needs careful monitoring.

Source: www.nejm.org

Amivantamab-Lazertinib Prolongs Overall Survival in EGFR-mutated Advanced Non-small-cell Lung Cancer

Date: October 30, 2025

Non-small-cell lung cancer (NSCLC) is one of the top cancers for new cases and cancer-related deaths in Hong Kong. Various treatment approaches have been approved to target relevant molecular derangements associated with genetic mutations in advanced NSCLC. Although third-generation EGFR-tyrosine kinase inhibitor has been the mainstay of EGFR-mutated advanced NSCLC, drug resistance may become inevitable over time and other clinical alternatives would be required.

The MARIPOSA trial is a phase 3, international, randomized trial comparing the efficacy and safety of amivantamab-lazertinib against osimertinib as first-line therapy in EGFR-mutated advanced NSCLC. A total of 1074 eligible participants were randomized in 2:2:1 ratio to receive (1) amivantamab-lazertinib therapy (n=429), (2) oral osimertinib (n=429) and (3) oral lazertinib (n-216) alone. Patients treated with amivantamab-lazertinib were given weekly amivantamab intravenous infusion for 4 weeks and maintenance infusions every 2 weeks, alongside with oral lazertinib 240mg daily. Overall survival defined as the time from randomization to death from any cause was the key primary endpoint of the current study.

With a median follow-up period of 37.8 months, the amivantamab-lazertinib group was shown to have significantly longer overall survival than conventional osimertinib therapy (hazard ratio for death=0.75, 95% confidence interval [CI], 0.61-0.92, P=0.005). The median time to symptomatic NSCLC progression was also longer in the amivantamab-lazertinib group, as compared with osimertinib alone (hazard ratio=0.69, 95% confidence interval [CI], 0.57-0.83). Yet, the incidence of grade 3 or higher adverse events was more prevalent in amivantamab-lazertinib group (80%) than the osimertinib group (52%).

In conclusion, amivantamab-lazertinib showed clinical significance in prolonging overall survival among EGFR-mutated advanced NSCLC patients as compared with osimertinib.

Source: www.nejm.org

Fish-Oil Supplementation Reduces Rate of Serious Cardiovascular Events in Patients Receiving Hemodialysis

Date: November 7, 2025

Cardiovascular disease is the leading cause of death in patients receiving hemodialysis, yet effective preventive strategies remain limited. Marine n-3 polyunsaturated fatty acids have cardioprotective effects in the general population, but their benefit in dialysis patients has been uncertain.

In a double-blind, randomized, placebo-controlled trial conducted at 26 sites in Canada and Australia (PISCES), adults on maintenance hemodialysis were assigned to receive either fish-oil capsules (4 g/day of n-3 fatty acids, providing 1.6 g EPA and 0.8 g DHA) or a corn-oil placebo. The primary outcome was a composite of serious cardiovascular events, including sudden and non-sudden cardiac death, fatal and nonfatal myocardial infarction, peripheral vascular disease leading to amputation, and fatal or nonfatal stroke. Secondary outcomes were extended from the primary outcome, adding noncardiac death, the individual components of the primary endpoint, and time to the first cardiovascular event or death from any cause.

A total of 1228 participants were randomised, with 610 assigned to fish oil and 618 to placebo, and were followed for a median of 3.5 years. The rate of serious cardiovascular events was significantly lower with fish oil than with placebo (0.31 vs. 0.61 per 1000 patient-days; hazard ratio, 0.57; 95% confidence interval, 0.47 to 0.70; P<0.001). Outcomes like noncardiac deaths, cardiac death, myocardial infarction, amputation, and stroke, and the composite of first cardiovascular event or death from any cause were all reduced with fish-oil supplementation. Meanwhile, adherence and overall adverse event rates were similar in the two groups.

To summarise, these findings show that high-dose fish-oil supplementation significantly lowers serious cardiovascular events in patients receiving hemodialysis than placebo, providing a possible therapy choice for these patients.

Source: www.nejm.org

Evolocumab Lowers Risk of First Cardiovascular Event in Patients without Previous Myocardial Infarction or Stroke

Date: November 8, 2025

Elevated low-density lipoprotein (LDL) cholesterol is yet a major modifiable risk factor for atherosclerotic cardiovascular disease. While statins are the basis of lipid-lowering therapy, the recent development of PCSK9 inhibitors provide an additional choice for intensive LDL reduction. Evolocumab, a monoclonal antibody targeting PCSK9, has demonstrated cardiovascular benefit in secondary prevention, but its role in primary prevention has been less certain.

A recent international, randomized, double-blind, placebo-controlled trial investigated whether evolocumab could reduce the risk of first cardiovascular events in adults without prior myocardial infarction or stroke but at elevated cardiovascular risk. Eligible participants were on optimised lipid-lowering therapy for at least 2 weeks and had LDL cholesterol levels above 2.3 mmol/L, non-HDL cholesterol levels of at least 3.1mmol/L and apolipoprotein B level of at least 80 mg/dL. Participants were assigned to receive either evolocumab (140 mg every two weeks) or placebo, in addition to standard therapy.

The primary outcome was the composite incidence of cardiovascular death, myocardial infarction or stroke (3-point MACE) and a composite of 3-point MACE or ischemia-driven arterial revascularisation (4-point MACE).

A total of 12,257 patients were enrolled (6129 evolocumab, 6128 placebo). The median age was 66 years, and the median follow-up duration was 4.6 years. Evolocumab significantly reduced the risk of 3-point MACE compared with placebo (6.2% vs. 8.0%; hazard ratio [HR], 0.75; 95% confidence interval [CI], 0.65–0.86; P<0.001). For the 4-point MACE, the 5-year Kaplan–Meier estimates were 13.4% with evolocumab and 16.2% with placebo (HR, 0.81; 95% CI, 0.73–0.89; P<0.001).

These findings indicate that evolocumab effectively lowers LDL-C and significantly reduces the risk of a first cardiovascular event in diabetic or atherosclerotic patients without prior myocardial infarction or stroke, reinforcing the role of PCSK9 inhibition in primary prevention for high-risk individuals.

Source: www.nejm.org

Sacituzumab Govitecan Therapy Extends Progression-free Survival in Untreated Advanced Triple-Negative Breast Cancer

Date: November 13, 2025

Triple-negative breast cancer is characterized by the lack of expression of estrogen receptor and progesterone receptor and no overexpression of human epidermal growth factor receptor 2 in tumour cells. Thus, patients diagnosed with triple-negative breast cancer are unlikely to benefit from hormonal therapies with limited treatment options. Sacituzumab govitecan, an antibody-drug conjugate with a potent topoisomerase I inhibitor, targets trophoblast cell-surface antigen 2 (Trop-2) that is highly expressed in triple-negative breast cancer with potential clinical benefits.

In this phase 3, international, open-label and randomized trial, 558 patients diagnosed with untreated advanced triple-negative breast cancer and PD-L1-negtive tumours were assigned in a 1:1 ratio to receive (1) intravenous sacituzumab govitecan at a dose of 10 mg/kg on day 1 & 8 of a 21-day cycle (n=279) or (2) protocol-specified chemotherapy (n=279) as standard of care until disease progression or death. Choices of protocol-specified chemotherapy include paclitaxel albumin or gemcitabine-carboplatin as determined before randomization. The primary endpoint was progression-free survival defined as the time from randomization to disease progression or death from any cause.

As of data-cutoff date in April 2025, the median progression-free survival was 9.7 months with sacituzumab govitecan and 6.9 months with active control (stratified hazard ratio for disease progression or death=0.62, 95% confidence interval [CI], 0.50-0.77, P<0.001). An objective clinical response was also confirmed by blinded central reviewers in 48% of patients receiving sacituzumab govitecan (95% confidence interval [CI], 42-54%) and 46% in the chemotherapy group (395% confidence interval [CI], 40-52%). The incidence rate of grade 3 or above adverse event were similar in both treatment groups.

To summarize, sacituzumab govitecan prolongs progression-free survival in comparison with chemotherapy among patients with advanced triple-negative breast cancer who were not suitable candidates for PD-1 or PD-L1 inhibitors.

Source: www.nejm.org

Blazing a Nontraditional Trail - An Interview with Ms. Anita Chan

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ABSTRACT

This article presents an interview with Ms. Anita Chan, a pharmacist whose distinguished career spans community pharmacy, non-governmental organization (NGO) leadership, and executive roles within the pharmaceutical industry. The discussion traces her unconventional path from frontline patient care in the U.S. to her pivotal role in founding the innovative Pharm+ outpatient service at St. James' Settlement in Hong Kong, and subsequently to her different roles at Pfizer and Viatris. Ms. Chan reflects on the critical skills and mindset required for these transitions, emphasizing adaptability, observant listening, and a solution-oriented approach to overcome uncertainty. She articulates a leadership philosophy guided by the principle of being "like water" — flexible and humble — while never forgetting one's foundational commitment to patient care. The interview concludes with advice for early-career pharmacists, encouraging exploration, continuous learning, and maintaining passion to navigate the profession's vast possibilities and achieve a fulfilling career.

INTRODUCTION

Ms. Anita Chan is currently the Head of Innovative Product Planning for Greater China at Viatris. She also holds academic appointments as an Honorary Assistant Professor at the University of Hong Kong and an Adjunct Assistant Professor at the Chinese University of Hong Kong. She earned her Bachelor of Pharmacy from the University of Iowa and began her career as Director of Operations at Sam's Club Pharmacy in the U.S. After returning to Hong Kong in 2009, she played a pivotal role in establishing the community pharmacy at St. James' Settlement and served as Pharmacy Manager. She later joined Pfizer, advancing through roles in medical affairs and marketing to become General Manager of both Pfizer and Viatris. With experience spanning frontline care and strategic leadership, Ms. Chan is a respected leader in pharmacy.

INTERVIEW WITH Ms. ANITA CHAN

Q: Can you tell us about your early experiences as a community pharmacist in the U.S.?

Anita: Initially, I had planned to attend medical school and become a surgeon after completing my pharmacy degree. I decided to take a gap year before applying — but that gap year gradually turned into several years. During that time, I began working as a staff pharmacist at a community pharmacy in a small town in the states. It was there that I met Alice, the pharmacy manager, who truly embodied the principles of pharmaceutical care. She had an incredible ability to notice the smallest details and build trust with patients. I vividly remember a case where her attentiveness helped uncover a situation of domestic abuse — she supported the patient in getting the help she needed. That moment left a deep impression on me. When Alice eventually moved on, I stepped into the role of pharmacy manager. My time there showed me how meaningful and impactful community pharmacy could be, and it ultimately convinced me to stay in the profession. The experience shaped not only my career path but also my understanding of the vital role pharmacists play in patient care.

Q: Can you tell us more about the experience in setting up St. James' Settlement Pharmacy?

Anita: Back in 2009, Pharm+ at St. James' Settlement introduced an innovative outpatient pharmacy service under a non-governmental organization (NGO) model. The aim was to bridge the gap between the public healthcare system and underserved patients, particularly the elderly. From our outreach work in the community, we identified a significant need — many elderly patients were confused about their medications, unsure of how to take them or what they were for. We wanted to deliver pharmaceutical care that went beyond dispensing, focusing on education, access, and personalized support.

I was brought on board as the Pharmacy Manager to help build this service from the ground up. When I first started, all we had was a physical location on the 8th floor of a building — no pharmacy license, no premises permit, and none of the basic infrastructure in place. At that time, it was very rare for the Department of Health to approve a pharmacy license for an upstairs location unless it was part of a shopping mall, which made the application process particularly challenging. I had to oversee everything from navigating regulatory requirements to ensuring the proper environmental conditions for medication storage, including temperature and humidity control.

Beyond the logistics, I was committed to setting up a space that allowed for real pharmaceutical care. We designed private consultation areas where pharmacists could sit down with patients to provide counseling in a comfortable and confidential setting. We also realized that financial barriers were a major reason for poor medication adherence among the elderly. Some patients would take only half a dose to make their supply last longer. To address this, we studied the Hospital Authority's drug formulary and introduced a financial subsidy program for self-financed medications. This service was appointment-based, allowing social workers to assess patients' financial needs and facilitate access to subsidized medications.

The financial subsidy initiative was a win-win-win model — for the NGO, the patients, and pharmaceutical companies. I worked closely with pharma partners to secure sponsorships for patients who were both financially and medically in need. In return, pharmaceutical companies had the opportunity to introduce their products to the public sector, as NGO staff would pitch their drugs to doctors in public hospitals after reviewing the relevant clinical data. GSK was our first partner in this initiative, generously sponsoring medications for eligible patients. We also implemented other forward-thinking services, such as telepharmacy through video calls — an especially novel concept at the time — and visual aids for patients with visual impairments or low literacy. These tools helped ensure that patients fully understood how to take their medications correctly and safely.

Setting up the pharmacy at St. James' Settlement was one of the most challenging yet rewarding experiences of my career. It reinforced my belief in the importance of pharmaceutical care and the pharmacist's role in creating patient-centered, accessible healthcare solutions.

Q: At what point did you decide to move from community pharmacy into the pharmaceutical industry? What influenced that decision?

Anita: One of the key reasons I eventually transitioned from community pharmacy into the pharmaceutical industry was related to my personality. I've always been someone who doesn't like to stay in one place or setting for too long — I thrive on new challenges and continuous growth. While I deeply valued my work at St. James' Settlement and the impact we were making in pharmaceutical care, I started to feel the urge to explore a different side of healthcare.

During my time at St. James', I had the opportunity to meet Mr. Stephen Leung, who was the General Manager of Pfizer at the time. He became a mentor, teacher, and an inspiring leader to me. One day, he asked if I would consider trying out a role in the pharmaceutical industry. I was open to new experiences, so I said yes — and that's how I started my journey at Pfizer as a Medical Affairs Manager for vaccines. Eventually, I also moved into marketing roles, which gave me a broader perspective on how the industry operates.

Although the setting changed, my commitment to pharmaceutical care remained the same. I believe that community pharmacy allows pharmacists to deliver care directly to patients, but the pharmaceutical industry also plays a crucial role in the healthcare ecosystem. In medical affairs, we ensure that the information shared with healthcare professionals is accurate, evidence-based, and unbiased. In marketing, we have the responsibility to promote products ethically and transparently so that patients and providers can make informed decisions. Both functions ultimately contribute to better patient outcomes, just through different avenues.

Importantly, I've also been able to leverage the network and resources available in the pharmaceutical industry to support patient education initiatives. By collaborating with healthcare professionals and using the tools provided by the company, we've been able to deliver educational programs that empower patients, improve adherence, and ultimately enhance health outcomes. This has been a deeply fulfilling part of my work.

This shift allowed me to continue contributing to pharmaceutical care in a broader, more systemic way — something that aligned with both my values and my desire for continuous growth.

Q: What were some of the most important skills you had to develop as you moved up the corporate ladder?

Anita: One of the most important skills I had to develop as I progressed into senior leadership roles was flexibility. In such a role, you're constantly juggling the needs and priorities of different departments, from medical and marketing to sales and regulatory. Each team has its own goals and perspectives, and it's crucial to find a balance that respects their input while still driving overall business success. At the end of the day, every decision must not only align with the company's values but also ensure its profitability and sustainability.

A philosophy that has guided me throughout my journey can be captured in eight Chinese characters that I hold dear: 上善若水，無忘初心. The first part, "The highest virtue is like water," reminds me to stay adaptable, humble, and responsive to change — just like water that takes the shape of its container. The second part, "Never forget why you started," keeps me grounded in my original passion for healthcare and pharmaceutical care. These principles have helped me grow not just as a leader, but as a person who strives to make meaningful contributions in every role I take on.

Q: Your career path is quite unconventional for a pharmacist. How did you handle uncertainty during transitions and adjust into the new environment?

Anita: My career path has indeed been unconventional, and navigating its transitions required a significant shift in mindset. My pharmacy training was inherently rigid, providing a very structured framework for patient care. However, I quickly learned that to succeed in diverse workplaces, I had to become profoundly accommodating and flexible. My primary strategy was to approach each new environment with a mindset of observation and listening, prioritizing understanding the established workflows and valuing the opinions and experiences of my new colleagues.

I adopted a principle of not dismissing new ideas or methods outright. Instead of saying "no" at first, I made a conscious effort to explore alternatives and understand the underlying rationale behind different processes. This approach allowed me to integrate more smoothly into new teams, demonstrate respect for existing cultures, and ultimately find innovative solutions that blended my unique pharmaceutical expertise with the needs of the new role. It taught me that uncertainty is best handled not with rigidity, but with adaptive curiosity and a solution-oriented attitude.

Q: What encouragement would you like to share with young pharmacists who are unsure of their future paths?

Anita: The advice I want to share isn't just for young pharmacists — it applies to all pharmacists, regardless of where they are in their careers. The pharmacy profession is full of possibilities, and sometimes the key is simply to be open to them.

Don't be afraid to explore. Try new roles, venture into unfamiliar areas, and allow yourself the freedom to grow. Whether it's community pharmacy, hospital, or industry, each experience will teach you something valuable. You might not know where you'll end up, but every step will shape your path.

Stay positive, especially during tough times. Everyone goes through ups and downs in their career journey. It's during the difficult moments that your mindset matters most. Believe in your abilities, and remember that challenges are part of growth.

At the same time, stay humble. With the rapid development of AI, new technologies, and emerging therapies, the healthcare landscape is constantly evolving. That's why it's so important to keep learning, stay curious, and embrace change. Use new tools and knowledge to seek out new opportunities. Never stop equipping yourself — what you learn today could open the door to your next big opportunity tomorrow.

Above all, stay passionate about your work. Passion fuels purpose, and purpose is what keeps us going even when the path is unclear. Whether you're helping one patient or leading a team, that passion will shine through and make a difference.

When I look back on my life, I feel grateful. I've raised two wonderful children, experienced different roles across various sectors, and stayed true to my commitment to pharmaceutical care. I've done my best, and I have no regrets. My hope is that the readers of this article — especially those who may be feeling unsure — will one day look back and feel the same sense of fulfillment.

CONCLUSION

Ms. Anita Chan's unconventional career path demonstrates that a pharmacist's impact extends far beyond a single practice setting, defined instead by a core commitment to patient care. Her journey from community pharmacy to NGO founder and industry executive serves as a powerful blueprint for professional adaptability, guided by a philosophy of being fluid like water while remaining anchored to one's original purpose. Ultimately, her story is an inspiring testament to the vast possibilities within pharmacy, encouraging professionals to embrace uncertainty with curiosity and passion to blaze their own unique and fulfilling trails.

Author's background

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Probiotics in Healthcare: From Gut Health to Systemic Effects - A Narrative Review

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ABSTRACT

Probiotics are live microorganisms that provide health benefits when consumed in sufficient quantities. Their scope has expanded from traditional fermented foods to include supplements with broad therapeutic potential. This article examines probiotics, along with prebiotics and postbiotics, covering their definitions, sources, and key characteristics like strain specificity, dosage (measured in colony-forming units, CFU), and survival in the gut through techniques such as microencapsulation. While probiotics are well-established for managing gastrointestinal conditions like antibiotic-associated diarrhea and irritable bowel syndrome, contemporary research reveals far-reaching systemic benefits. Their influence extends to the gut-brain axis, where they can improve cognitive function, mood, and sleep quality. They also modulate immune function by stimulating protective antibodies and anti-inflammatory pathways and can regulate skin health through the gut-skin axis, benefiting conditions like acne and atopic dermatitis. Despite their promise, practical application faces challenges, including regulatory inconsistencies and the fact that benefits are often strain-specific. This underscores the need for evidence-based guidance. Healthcare professionals, especially pharmacists, play a vital role in advising patients on the appropriate selection and use of probiotics to achieve specific, targeted health outcomes.

Keywords: *probiotics, gut-brain axis, cognitive function, sleep, skin health, immunity*

INTRODUCTION

Although the term probiotic was not introduced until 1953 by German scientist Werner Kollath, who defined probiotics as "active substances that are essential for a healthy development of life", the use of probiotics dates back 10,000 years, to when humans first began producing fermented foods and beverages[1]. For centuries, probiotics have been an integral part of human nutrition. In recent decades, probiotics have growing recognition, driven by scientific advances that continue to expand our understanding of their health benefits.

The global probiotics market size was valued at USD 87.7 billion in 2023, with a projected Compound Annual Growth Rate (CAGR) of 14.1% from 2024 to 2030[2]. Once primarily associated with digestive health, probiotics are now scientifically validated for their far-reaching impacts, from strengthening immune defenses and alleviating skin disorders to enhancing cognitive function and potentially mitigating neurodegenerative conditions.

DEFINITION OF RELATED TERMS

Prebiotics

Prebiotic, as defined by the International Scientific Association for Probiotics and Prebiotics (ISAPP) in 2008, is "a selectively fermented ingredient that results in specific changes in the composition and/ or activity of the gastrointestinal microbiota, thus conferring benefit(s) upon host health". Probiotics ferment and degrade prebiotics to obtain energy for survival, thereby modulating the composition and function of gut microbiota[3]. Most prebiotics are carbohydrate-based, primarily oligosaccharides, including fructans, galacto-oligosaccharides and polydextrose. Additionally, dietary bioactives such as polyphenols, carotenoids, and phytosterols, function as prebiotics by selectively nourishing beneficial gut bacteria[4]. Natural sources of prebiotics include asparagus, barley, onion, garlic, seaweed, beans, tomatoes and bananas[3]. Given their crucial roles in health maintenance, prebiotics are also manufactured industrially on a large scale[3].

Probiotics

Although countless microorganisms exist in nature, only a small number qualify as probiotics. The Food and Agriculture Organization of the United Nations and the World Health Organization (FAO/WHO) define probiotics as "live microorganisms that, when administered in adequate amounts, confer a health benefit on the host", which was reaffirmed by ISAPP in 2014[5]. The definition of probiotics

carries four key implications[6]:

1. Probiotics are microorganisms, which can be bacteria or other microbes. They must be alive when administered.
2. They need to be administered, typically via the oral route or other routes.
3. They must be present in sufficient amounts, meaning there should be at least as many viable microbes in the product at the end of its shelf life as were used in clinical studies.
4. They must confer a health benefit, which should be demonstrated in the target host population.

Postbiotics

In 2019, the ISAPP panel defined a postbiotic as a "preparation of inanimate microorganisms and/or their components that confers a health benefit on the host"[7]. Postbiotics consist of deliberately inactivated microbial cells, with or without their metabolites or cell components, that contribute to proven health benefits. They are generally classified into five main categories: enzymes, short-chain fatty acids, cell wall fragments, exopolysaccharides, and other metabolites, including organic acids and vitamins[8].

PROBIOTICS & GUT MICROBIOTA

The human gastrointestinal (GI) tract hosts a dynamic and diverse ecosystem of microorganisms. The gut microbiota, a complex community comprising trillions of microbes (approximately 10^14 bacteria representing 2,172 species), plays a vital role in regulating metabolism and maintaining host homeostasis[9]. This relationship is fundamentally mutualistic. While the human body provides nutrients and a stable environment, the gut microbiota reciprocates by contributing to nutritional processes and preserving the physiological health of the intestinal mucosa[10]. Alterations in its composition can cause a metabolic shift, leading to changes in the host's phenotype. The key to gut health is preserving a flexible, well-balanced microbial ecosystem in a stable intestinal environment[11]. Such imbalances, known as dysbiosis, not only contribute to gastrointestinal disorders but are also strongly associated with dysfunction and diseases in other organ systems, including the brain, skin, lungs, kidneys, endocrine system, heart, and muscles[11].

Probiotics help maintain intestinal homeostasis via two primary mechanisms,1. by promoting the growth of beneficial endogenous microbial populations and 2. through the competitive exclusion between probiotics and pathogenic bacteria for nutrients and ecological space, thereby inhibiting harmful bacterial growth while enhancing colonization of beneficial strains[11].

SPECIES OF PROBIOTICS

Probiotics are genetically classified and named according to their genus, species, and strain. The most commonly used microorganisms in probiotic formulations include species from the genera Bifidobacterium, Saccharomyces, Streptococcus, Enterococcus, Escherichia, and Bacillus. Below is a table demonstrating three representative examples of this classification system :

Genus	Species	Strain
Bifidobacterium	*Lactis*	DN-173 010
Lactobacillus	Plantarum	DSM 13273
Lactobacillus	rhamnosus	GG

SOURCE OF PROBIOTICS

Historically, dietary probiotics were primarily obtained from fermented foods. They are produced through the metabolic activity of a variety of live microbial cultures. While yogurt often contains probiotic strains from *Bifidobacterium* or *Lactobacillaceae*, other fermented foods with live cultures, such as cheese, kimchi, miso, pickles and apple cider vinegar , do not necessarily contain clinically validated probiotic microorganisms. In recent years, probiotic supplements have gained significant popularity alongside traditional vitamin and mineral supplements. These probiotic formulations are commercially available in diverse delivery forms including capsules, powders, candies, and liquids, each offering various microbial strains and doses to meet different health needs.

PROPERTIES OF PROBIOTICS

Quantity of probiotics

Probiotic content is quantified in colony-forming units (CFU), representing the number of viable cells capable of proliferation and colony formation. The effective dosage varies significantly among different strains and indications, making it impossible to establish a universally recommended dose. Take the treatment of irritable bowel syndrome (IBS) as example, *Bifidobacterium longum subsp. longum 35624* demonstrates efficacy in alleviating the symptoms of IBS at 100 million CFU/day while the effective dose of other probiotic products is 300–450 billion CFU administered three times daily. Therefore, dosage recommendations should always be guided by clinical studies demonstrating specific health benefits rather than generalized guidelines .

Since probiotics are live microorganisms, they are susceptible to loss of viability during transportation and storage. To compensate for this, manufacturers typically add extra amounts of probiotics to guarantee that the labeled potency is maintained throughout the product's shelf life[14]. Hence, the CFU amount indicated on the package should reflect the number available at the end of the product's shelf life, rather than at the time of manufacture. It is also important to note that a higher CFU count does not necessarily correlate with greater health benefits[12].

Probiotics & acidity of gastric juice

To exert their beneficial effects, probiotics must survive the passage through the acidic gastric environment so they can reach the large intestine in adequate amounts to colonize and proliferate[15]. However, most probiotics cannot survive in sufficient quantities due to the stomach's low pH[16]. Resistance to stomach acid and tolerance to bile salts are two fundamental properties of probiotics, enabling

them to survive in the small intestine with their presence[17]. Microencapsulation, the most common protective strategy, involves coating the probiotics with the minuscule capsule[18] that shields them from various physical and chemical stresses (including humidity, heat, pH, and harmful substances[19]). Protective matrices such as alginate, chitosan, or cellulose derivatives help shield probiotics from gastric acid and enable their controlled release in the intestines[20].

Single- & multi-strain probiotics

The efficacy of probiotics can vary depending on whether they contain a single strain or multiple strains, with each formulation offering distinct advantages. Single-strain probiotics, such as *Lactobacillus rhamnosus GG or Saccharomyces boulardii*, have been well-studied for specific conditions, demonstrating targeted benefits such as reducing antibiotic-associated diarrhea[21]. In some cases, multi-strain probiotics may provide broader benefits due to synergistic interactions. For example, a mixture of *L. rhamnosus GG and B. lactis Bb12* was significantly more effective than *L. rhamnosus GG alone for eradicating H. pylori*[22].

PROBIOTICS AND HEALTH

Probiotics contribute to health maintenance, offering a wide range of benefits that extend far beyond their well-known role in gastrointestinal health. They exert profound effects on multiple physiological systems. As science continues to unravel the complex interactions between probiotics and human physiology, their role in preventive and therapeutic medicine appears to be increasingly significant.

Gut health

The gastrointestinal tract represents the largest microbial reservoir in the human body. The effects of probiotics on intestinal diseases are the most extensively studied. They exert multiple protective mechanisms by preventing pathogenic bacteria from adhering to the intestinal epithelium, stimulating production of inhibitory agents[23], enhancing local immune responses[24], and maintaining optimal short-chain fatty acid levels[25]. Additionally, probiotics modulate immune function by suppressing proinflammatory cytokines[25], repairing intestinal permeability[26], inhibiting the growth of pathogenic bacteria through direct binding (particularly to gram-negative species)[27], and upregulating intestinal electrolyte absorption[24]. Clinical evidence supports the therapeutic use of probiotics for several gastrointestinal disorders, including:

1. **Acute Infectious Diarrhea**
   Clinical evidence demonstrates that probiotics are effective against acute infectious diarrhea of bacterial origin, though their efficacy against viral diarrhea remains inconsistent. A comprehensive Cochrane review analyzing 63 randomized controlled trials (RCTs) and quasi-RCTs involving 8,014 participants (including infants, children, and adults) reveals that probiotic supplementation reduces the average duration of diarrhea by 25 hours and decreases the likelihood of prolonged diarrhea (lasting for ≥4 days) by 59%[28].

2. **Antibiotic-Associated Diarrhea, Clostridium difficile (C. difficile) Infection, and C. difficile-Associated Diarrhea**
   Probiotics show clinical efficacy in both preventing and treating antibiotic-associated diarrhea and preventing *C. difficile*-associated diarrhea across all age groups. A Cochrane analysis of 23 pediatric studies (3,938 participants) demonstrates significantly lower incidence rates of antibiotic-associated diarrhea in probiotic-treated groups versus controls[29]. The studies also reveal a reduced risk of antibiotic-associated diarrhea, including *C. difficile*–associated diarrhea and culture-negative diarrhea, as well as significantly lower stool frequency, higher recovery rates, and a shorter mean duration of diarrhea[30].

3. **Irritable Bowel Syndrome (IBS) and Functional Abdominal Pain**
   Evidence supports the moderate efficacy of probiotics for managing IBS symptoms in adults and children, as well as functional abdominal pain in pediatric populations. A guideline by the American College of Gastroenterology incorporating 23 clinical trials (2,575 participants) documents significant probiotic-mediated improvements in global IBS symptoms, bloating, and flatulence compared to placebo[31]. Similarly, pediatric meta-analyses confirm greater treatment success rates with probiotics versus placebo for both IBS and functional abdominal pain[32].

4. **Constipation**
   Probiotic interventions demonstrate therapeutic benefits for constipation in both pediatric and adult populations. In children, a small randomized controlled trial (n=59) reveals that Bifidobacterium-enriched yogurt outperformed conventional yogurt in improving defecation frequency while reducing abdominal pain and painful defecation[33]. A meta-analysis involving 10 peer-reviewed studies shows that the substantial majority (70%) reports positive results in the treatment of functional and chronic constipation. However, the variability in probiotic strains, dosages, and study designs among the studies necessitates further investigation to establish the optimal regimen[34].

Cognitive function & Mood disorder

The enteric nervous system is often described as our “second brain”. The gut-brain axis (GBA) is a bidirectional communication network linking the gut microbiota to the central nervous system via pathways such as the hypothalamic-pituitary-adrenal (HPA) axis, autonomic nervous system (ANS), enteric nervous system (ENS), and central nervous system (CNS), forming a critical element of this axis. It is essential to note that this is an emerging field; the evidence base, while promising, requires replication in larger, more robust studies. Current research reveals that gut microbiota significantly influences this axis , with probiotics demonstrating considerable potential to enhance cognitive function through several interconnected mechanisms as follows:

1) Neurotransmitter modulation: Probiotics stimulate the production of gamma-aminobutyric acid (GABA)

and brain-derived neurotrophic factor (BDNF), both are essential for learning (spatial learning, extinction of conditioned fear, object recognition), memory processes and mood regulation . For example, Lactobacillus rhamnosus JB-1 has been shown to upregulate GABA receptor expression in the brain, hence reducing stress-induced corticosterone, and improving cognitive performance[38].

2) Reduction of neuroinflammation: Probiotics can address neuroinflammation, which is strongly associated with cognitive decline, neurodegenerative diseases, and mood regulation. Specific strains, such as Bifidobacterium breve, have been shown to decrease levels of pro-inflammatory cytokines (e.g. IL-6, TNF-α) in the hippocampus, thereby protecting against memory impairment[39] and mood disorders, including anxiety and depression[40].

3) Short-chain fatty acids (SCFAs) and brain health: SCFAs, particularly butyrate, are produced by probiotics and contribute to brain health by crossing the blood-brain barrier. They promote neuronal growth and neurogenesis, hence strengthen the brain's protective barriers by enhancing the expression of tight junction proteins that guard against neurotoxins[41].

1. Alzheimer's Disease

In a small 12-week study (n=60), Alzheimer's patients receiving probiotics showed statistically significant improvements in Mini-Mental State Examination (MMSE) scores (cognitive assessment score) compared to control groups[42]. Furthermore, probiotic supplementation improved markers of oxidative stress in mild to moderate Alzheimer's cases, as shown by increased serum glutathione (GSH) and decreased levels of 8-hydroxy-2'-deoxyguanosine (8-OHdG) and malondialdehyde (MDA). Another small 12-week study (n=90) shows the additional benefits of better quality of life and greater physical activity among participants[43]. While preliminary studies on probiotics and Alzheimer's disease show promising results, it is important to note that the findings come from relatively small-scale clinical trials. Until more robust evidence is available, probiotics should be considered an experimental rather than established therapeutic approach for Alzheimer's disease.

2. Mild Cognitive Impairment (MCI)

Two separate small 12-week investigations report that probiotic administration not only enhances cognitive performance but also improves sleep quality and gastrointestinal function in elderly MCI patients (n=42)[44]. Moreover, computerized neurocognitive assessments identified significant improvements in overall cognitive function, with benefits in attention domains, when compared to placebo groups (n=100)[45]. These cognitive enhancements were associated with increased serum BDNF levels and notable increases in Lactobacillus populations in the participants' gut microbiota.

3. Anxiety and Depression

Certain probiotic strains, often referred to as "psychobiotics", appear to modulate neurotransmitter production, reduce inflammation, and improve gut barrier function. All these effects may influence mood and emotional regulation[46]. A systematic review has shown that probiotics, particularly strains of Lactobacillus and Bifidobacterium, may improve symptoms associated with major depressive disorder by increasing serotonin availability and decreasing levels of inflammatory markers[47]. Similarly, a small randomized controlled trial (n=10) reports that a multi-strain probiotic (containing *L. helveticus R0052* and *B. longum R0175*) reduces anxiety and improves emotional processing in healthy participants[48]. However, results are not uniform across all studies. A systematic review notes that while some trials show significant benefits, others report minimal effects, possibly due to differences in strain selection, dosage, treatment duration, and individual microbiome variability[49]. For instance, *Lactobacillus rhamnosus* has been associated with reduced anxiety in animal studies but may not have the same effect in human populations[38]. It is therefore critical to emphasize that probiotics should not be considered a standalone treatment for psychiatric disorders. They are not a replacement for established therapies such as psychotherapy, pharmacotherapy, or clinical management under professional supervision. Despite these promising findings, probiotics should not yet be considered a standalone treatment for anxiety or depression. Future research is required to identify the most effective strains and optimal treatment protocols for maximizing mental health benefits.

Sleep

The growing global prevalence of insomnia has spurred innovation in developing novel sleep support interventions. Current research reveals a clear association between poor sleep quality or quantity and gut microbiome dysbiosis. It is important to acknowledge that this area of research is emerging, and high-quality evidence from large randomized controlled trials (RCTs) remains limited. Probiotics have shown potential in improving sleep quality through various mechanisms, including the modulation of the gut-brain axis, production of sleep-promoting metabolites (interleukin (IL)-1β, SCFAs, serotonin (5-HT), γ-aminobutyric acid (GABA) and melatonin), and reduction of stress responses and anxiety. Notably, some of the observed sleep benefits may be indirect, resulting from a probiotic-mediated reduction in general anxiety or physiological stress. Clinical evidence highlights specific strains from *Lactobacillus* and *Bifidobacterium* genera as particularly effective in improving sleep. Notable examples include *Lactobacillus casei Shirota*, which reduces morning sleepiness and prolongs sleep duration in academically stressed students, and *Lactobacillus gasseri* (administered as a postbiotic), which produces significant improvements in the Pittsburgh Sleep Quality Index (PSQI) scores, especially among male subjects[50].

The underlying mechanisms involve neurotransmitter production (e.g., GABA, serotonin), regulation of immune responses (e.g., reducing proinflammatory cytokines), and circadian rhythm regulation through microbial metabolites such as SCFAs and bile acids. For instance, recent studies demonstrate that SCFAs can promote non-rapid eye

movement (NREM) sleep, while certain probiotics appear to enhance relaxation and sleep onset by lowering cortisol levels[50]. Moreover, the Epworth Sleepiness Scale (ESS) showed no statistically significant change after probiotic use, suggesting their selective effects on nighttime sleep quality without causing next-day drowsiness . However, the optimal probiotic strains, effective dosages, and required treatment durations for sleep support have yet to be firmly established.

Immunity

Two major breakthroughs in intestinal microbiology and immunology in recent years are: 1) the discovery that gut microbiota serves as primary modulators of the host's internal environment, and 2) evidence that both the composition and metabolic products of intestinal microorganisms exert substantial influence on the immune response[52]. Probiotics play a crucial role in strengthening both mucosal and systemic immunity. One key pathway involves stimulating the production of secretory immunoglobulin A (sIgA), which are proteolytically resistant antibodies that prevent pathogenic adhesion to the intestinal epithelium. Probiotic strains including *Lactobacillus casei* and *Bifidobacterium breve* have been shown to enhance sIgA production via interactions with gut-associated lymphoid tissue (GALT)[10], thereby reinforcing antimicrobial defenses. While these mechanisms are well-supported by in vitro and animal research, confirming their translation into reliable and predictable effects in humans requires further clinical validation.

Probiotics also exhibit sophisticated immunomodulatory capabilities by simultaneously promoting anti-inflammatory cytokines (such as IL-10) and inhibiting pro-inflammatory mediators (such as TNF-α and IL-6). Specific strains, like Lactobacillus rhamnosus GG, demonstrate efficacy in supporting regulatory T-cell (Treg) activity, thereby maintaining immune homeostasis and preventing excessive inflammatory responses[10]. Individual variation including genetics, baseline microbiome composition, and immune status can significantly influence the responsiveness to these immunomodulatory effects.

The immunomodulatory effects extend to microbial metabolites, particularly SCFAs, such as butyrate. They are produced by intestinal microorganisms that can enhance the epithelial barrier function by reaching the other organs and acting on antigen-presenting cells, hence reduce the inflammation in related diseases[52]. They also increase antimicrobial peptides, which help fight a wide range of harmful pathogens . The results of multiple studies confirm the beneficial effect of probiotic microorganisms on the balance of the intestinal microbiome and the production of metabolites[54].

Probiotics have also been found to reduce both the incidence of acute respiratory tract infections and the need for antibiotics[55]. A systematic review of 9 studies shows that the oropharyngeal probiotic *Streptococcus salivarius K12*, which colonizes the oropharyngeal mucosa, may help reduce the occurrence and/or severity of acute otitis media and secretory otitis media in children . Another systematic review of 4 articles (n=1846) reveals that *S. salivarius K12's* can significantly reduce the occurrence of streptococcal pharyngitis, further highlighting the broad immunological benefits conferred by probiotic supplementation[57]. These collective findings reinforce the crucial relationship between probiotic microorganisms, their metabolic byproducts, and comprehensive immune system regulation.

Skin

Building upon the well-established gut-brain axis, researchers have identified a similar gut-skin axis which connects intestinal microbiota to skin health. When the intestinal microbiota becomes imbalanced, it may lead to autoimmune and inflammatory conditions that affect not only the gastrointestinal tract, but also distant organs, including the skin[58]. It is important to acknowledge that the current evidence, while promising, is primarily based on small-scale, preliminary studies, and larger, high-quality trials are needed to confirm these relationships. Increasing evidence indicates that the intestinal microbiome is closely related to common skin diseases[59]. In addition to oral probiotics, topical probiotic formulations have emerged as effective therapeutic options for various skin conditions. The optimal formulation strategy—oral, topical, or a combination—for specific skin conditions remains an active area of investigation. The following section focuses on the effects of probiotics on the two common skin disorders: atopic dermatitis and acne vulgaris.

1. **Atopic dermatitis**
   Atopic dermatitis, a common chronic inflammatory skin disease, has been strongly linked to alterations in the gut microbiome. Clinical observations reveal that patients with atopic dermatitis typically exhibit reduced populations of intestinal Bifidobacterium compared to healthy individuals, with its level inversely correlated with the disease severity[52]. Besides, therapeutic approaches of atopic dermatitis focus on barrier restoration[60], which can be achieved by topical probiotic formulations. In a small randomized, double-blind split-body clinical trial with patients with atopic dermatitis (n=28), emollients containing *Lactobacillus* is found to suppress the proliferation of *Staphylococcus aureus*, offering mechanical protection and symptomatic relief in patients with atopic dermatitis[61]. Oral ingestion of certain probiotic strains has also been shown to improve the skin barrier, enhance skin hydration, and reduce transepidermal water loss. A small randomized, double-blind, placebo-controlled study (n=64) investigating the effects of oral supplementation with *L. paracasei NCC2461* reveals improvements in both skin sensitivity and skin barrier function in the probiotic group. The probiotic group also shows an increase in serum concentration of TGF- β, a cytokine crucial for maintaining skin integrity, after 29 days, while there is no increase in the placebo group[62].

2. **Acne vulgaris**
   Acne vulgaris, another common skin disease, shows connections to dysfunction of the gut-skin axis. Probiotic interventions have demonstrated therapeutic potential by modulating systemic immune responses beyond the intestines, extending its effect

to skin health[63]. Specific strains, such as *Lactococcus sp. HY449*, exhibit direct antimicrobial activity against *P.acnes* through the production of antimicrobial proteins[60]. Increasing evidence suggests that probiotics also modulate the skin's mechanical barrier and increase antimicrobial peptides production. For instance, the lactic acid bacterium, *Streptococcus thermophiles*, promotes the synthesis of ceramide, which helps retain water in the skin and increases certain ceramide sphingolipids, including sphingomyelin. These sphingolipids enhance skin hydration and possess intrinsic antibacterial properties against acne-causing bacteria, such as *Cutibacterium acnes*[64]. Such probiotic approaches offer promising alternatives to conventional acne treatments, which often compromise skin barrier through excessive drying and irritation[64].

PRECAUTIONS & CONSIDERATIONS

Limitations of probiotics

Despite substantial research supporting the therapeutic benefits of probiotics for various health conditions, neither the European Food Safety Authority (EFSA) nor the U.S. Food and Drug Administration (FDA) has approved any health claims regarding their ability to prevent or treat medical conditions[65]. The principal reasons EFSA has denied approval of probiotic health claims include insufficient characterization, undefined or nonbeneficial claims, lack of relevant human studies, lack of measurable outcomes that reflect direct benefits for humans, and poor quality of the presented studies. An additional challenge is the strain-specific nature of probiotic effects, where benefits demonstrated by one strain cannot be extrapolated to others, even within the same species[66]. Furthermore, the current marketing landscape, where probiotic products are often promoted directly to consumers without clear evidence of clinical efficacy, presents significant regulatory challenges. This practice risks disseminating misleading information and highlights the critical need for healthcare professionals to provide evidence-based guidance on the appropriate use of probiotics[10].

Safety of probiotics

The safety profile of most probiotic strains is well-established through rigorous evaluation systems. The Qualified Presumption of Safety (QPS)[67] was developed by EFSA as a safety assessment approach for microorganisms intended for use in food or feed chains; it is a list of microbes, including bacteria, yeasts, filamentous fungi, and viruses, deemed safe for use in foods. Most bacterial species used as probiotics have obtained QPS status. In addition, probiotics are described as "generally recognized as safe (GRAS)" by the FDA[10]. Since the safety of probiotics is well established in most research, there is no contraindication. However, certain high-risk groups, including immunocompromised individuals, elderly patients, and those with short bowel syndrome, should consult healthcare providers before use[68], since a systematic review of 17 studies, including 1530 patients with cancer, found 5 cases of probiotic-related bacteremia, fungemia, or positive blood culture[69].

PHARMACISTS' ROLE IN THE COUNSELLING OF PROBIOTICS

While probiotics can be used in clinical treatments, they are more commonly available as over-the-counter supplements in Hong Kong[70]. Pharmacists can play a significant role in assisting patients to make informed decisions regarding the selection of probiotics products by providing individualized recommendations, as there is no one-size-fits-all approach to supplements. Patients should be reminded that the effectiveness of probiotics can be species, dose, and disease specific[69]. According to ISAPP guidance, probiotic product labels should disclose the all the genus, species, and strain in the product[66]. Pharmacists can help patients choose products with clear strain identification and select strains that address their desired health outcomes. Additionally, pharmacists should remind consumers to use probiotic products before the "use-by" date, as the CFU count may decline over the product's lifespan.

Moreover, the beneficial effects of probiotics may diminish within days to weeks after discontinuation, depending on the strain, dosage, duration of use, and individual factors such as gut microbiota composition . Pharmacists should remind patients that continuous probiotic intake may be necessary for maintaining sustained effects. However, in rare cases, some individuals, known as "persisters", can retain specific strains, such as Bifidobacterium longum for at least 166 days[72].

CONCLUSION

Probiotics have evolved from traditional dietary components to scientifically validated potential therapeutic agents, demonstrating remarkable potential across diverse areas of health. The growing evidence supporting their roles in immune modulation, skin health, and cognitive function suggests that we are only beginning to understand their full therapeutic potential. However, as with any intervention, proper strain selection, dosage and quality control remain crucial for optimal results. As we move forward, probiotics will likely play an increasingly important role in both maintaining wellness and managing disease, offering a natural, safe, and effective complement to conventional medical therapies.

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Questions for Pharmacy Continuing Education Program

2 CE Units

Probiotics in Healthcare: From Gut Health to Systemic Effects- A Narrative Review

1. ***Which of the following GI disorders show symptomatic improvement through probiotic use?***
   a. Ulcerative colitis
   b. Celiac disease
   c. Hemorrhoids
   d. Irritable bowel syndrome (IBS)

2. ***What is the function of probiotic microencapsulation?***
   a. To enable immediate release of probiotics in the intestines
   b. To confer protection from environmental factors
   c. To enhance the flavor of probiotics in food products
   d. To make probiotics more visually appealing in packaging

3. ***Which of the following probiotic strains has been shown to be effective in treating antibiotic associated diarrhea?***
   a. *Escherichia coli O157:H7*
   b. *B. lactis Bb12*
   c. *Lactobacillus rhamnosus GG*
   d. *Bifidobacterium bifidum*

4. ***Which of the below are mechanisms by which probiotics benefit cognitive function and mood disorder?***
   a. Stimulation of neurotransmitter production
   b. Upregulation of receptors
   c. Reduction in levels of pro-inflammatory cytokines
   d. All of the above

5. ***Which of the following is a potential benefit of probiotics in patients with Alzheimer's disease?***
   a. Reduced oxidative stress
   b. Increased grey matter mass
   c. Reduced incidence of sarcopenia
   d. Improved liver function

6. **What are some of the potential mechanisms by which probiotics can improve sleep quality?**
   a. Promoting the absorption of dietary carbohydrates and fats
   b. Production of IL-1β and melatonin
   c. Stimulation of the sympathetic nervous system
   d. Inhibiting GABA receptor expression

7. ***What is one key mechanism by which Lactobacillus rhamnosus GG can enhance immunomodulatory functions?***
   a. Increase production of IL-6 and TNF-α
   b. Inhibition of pathogenic bacterial proliferation
   c. Increase production of IL-10
   d. Activation of regulatory T-cells

8. ***What is one key mechanism by which probiotics can benefit patients with atopic dermatitis?***
   a. Promotion of trans-epidermal water loss
   b. Decrease in serum production of TGF-β
   c. Suppress proliferation of skin-bound *Staphylococcus aureus*
   d. Production of antimicrobial proteins exhibiting direct antimicrobial activity

9. ***Which option is NOT one of the limitations of probiotics?***
   a. Lack of relevant human studies up to quality standards
   b. Unclear evidence regarding human efficacy
   c. Limited safety profile in high-risk individuals such as those with short bowel syndrome
   d. Limited diversity of probiotic strains for targeted management of specific diseases

10. ***What are some of the key counselling points regarding probiotic supplementation in patients?***
    a. Beneficial effects of probiotics may vary greatly depending on each product
    b. CFU count of the product may decline past the "use-by" date
    c. Abrupt discontinuation of probiotic intake may lead to the halting of beneficial effects aside from a few rare cases
    d. All of the above

Answers will be released in the next issue of HKPJ.

CE Questions Answer for 322(D&T)

Review of Current CAR-T Therapy for adults Relapsed/Refractory Diffuse Large B-Cell Lymphoma: Tisagenlecleucel (Kymriah®) and Axicabtagene Ciloleucel (Yescarta®)

1. D 2. B 3. A 4. C 5. D 6. B 7. B 8. C 9. D 10. A

District-based Survey on Medication Management and Community Pharmacy Services Utilization of Hong Kong Citizens

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ABSTRACT

To plan for pharmacy services that cater for community needs, the Sha Tin District Health Centre Express (STDHCE) has conducted a survey in early 2024 to investigate the medication management and utilization of community pharmacy services by local residents in Sha Tin. A total of 733 replies were received, including members (94.1%) and nonmembers of STDHCE. The results revealed potential problems in medication management by citizens such as inappropriate side effects management, medication nonadherence, and lack of reliable and useful online information platforms to address their health or drug-related questions. Respondents also showed a low awareness of existing community pharmacy services available, while publicly perceived pharmacy service needs such as general drug consultation, medication management services, and minor ailment management and consultation were identified. As the current study focused on the Sha Tin population, more population-based studies would allow policy makers and service providers to develop services that address public needs.

Keywords: *Primary healthcare, Community pharmacy, Community pharmacist, Medication management, Public engagement*

INTRODUCTION

Needs assessment is the first step to devise services that address community needs. There has been an escalating development of community pharmacy services (CPS) in Hong Kong in recent years, such as serving as Community Collection Points for patients under the Hospital Authority (HA) opting for the Medication Delivery Service since 2023, and the Jockey Club PHARM+ Community Medication Service Network Project commenced in 2024.[1-3]

The Chief Executive's Policy Address announced in October 2024 has explicitly stated that there was a plan to "complete the establishment of a community drug formulary in Q4 2025 and launch a Community Pharmacy Programme (CPP) by phases starting from Q4 2026" as the ways forward to drive the development of CPS to support primary healthcare in Hong Kong.[4] This was reiterated in the Policy Address announced in September 2025, and the Community Drug Formulary mechanism and Guidelines of Practice for Community Pharmacy were announced in October 2025, highlighting the importance of setting standards and frameworks of pharmacy service to the HKSAR Government.[5,6] Hong Kong is about to embark on a great leap in the progress of pharmacist-led primary healthcare initiatives (e.g. CPP) with government support, new service models put forward in the Jockey Club PHARM+ Community Medication Service Network Project, the establishment of increasing number of non-governmental organization (NGO)-led community pharmacies and District Health Centres/Expresses with in-house pharmacists, and new service initiatives in other community pharmacies.

Nevertheless, local data on the general needs and opinions of citizens on CPS are scarce, outdated, or focused on specific needs (e.g. self-medication behaviors and the elderly).[7-9] The Sha Tin District Health Centre Express (STDHCE) has conducted a survey in early 2024 with the aim to understand the medication management practice and utilization of CPS by Sha Tin residents, and explore potential pharmacy service development.

METHODS

The anonymous survey was disseminated to members of STDHCE by electronic means and non-members through district newsletter and district partners from 1 March to 31 May 2024.

The quantitative survey in Chinese was designed to be self-administered online by respondents and included five sections: (1) basic demographics; (2) use of western medications and complementary medicines in the past one year; (3) treatment beliefs; (4) health information literacy; and (5) awareness and utilization of CPS. Section (3) on treatment beliefs adopted questions from the Beliefs about Medicines

Questionnaire - Specific (BMQ-Specific, including "Necessity" and "Concerns"), which includes questions that assess the beliefs about medicines for personal use, in turn affecting patient adherence.[10] A shortened version was employed so that two ("My life would be impossible without my medicines" and "My medicines protect me from becoming worse") and one item ("My medicines are a mystery to me") were removed from Specific-Necessity and Specific-Concerns, respectively. The two subscales demonstrated satisfactory internal consistency in the present study, with Cronbach's alpha values of .86 for the Specific-Necessity subscale and .84 for the Specific-Concerns subscale, respectively. Mean scores were generated for each sub-scale by averaging the item scores that range between 1 and 5.

One-way ANOVA and Chi-squared tests of independence were used to examine associations between sociodemographic characteristics (gender, age group, and education attainment) and treatment beliefs, health information literacy, awareness and perceived needs of CPS, and willingness-to-pay for CPS. Since a total of 99 comparisons were conducted in the above analysis, Bonferroni correction was applied to increase acceptable significance level to .0005 to reduce the likelihood of making Type I errors.

Univariate and multivariate logistic regression models were used to identify predictors of medication nonadherence among a sub-group of respondents who took chronic medications in the past year. Medication nonadherence was assessed with a single item asking patients taking chronic medications "When you feel your symptoms are under control, do you sometimes stop taking your medication?" (Yes/No). Predictors included gender, age (below 60 years old vs. 61 years or above), education attainment (primary or lower, secondary, tertiary or above), treatment beliefs (Specific-Necessity, Specific-Concerns), polypharmacy (taking 4 or fewer chronic medicines vs. 5 or more), use of supplements (Yes/No), Hospital Authority or Department of Health being the source(s) of the chronic medication (Yes/No), and experience of side effects (Yes/No). Except sociodemographic characteristics (age, gender, education), each covariate was entered to the univariate logistic regression model with medication nonadherence as the dependent variable. Only covariates demonstrated a statistically significant association ($p<.05$) were included in the final model along with the sociodemographic characteristics.

For the bivariate analyses, the sample size for the chi-squared test of independence was determined using an a priori power analysis. Based on detecting a conventional medium effect size ($w = 0.30$) with a standard alpha level of $\alpha = 0.05$ and 80% power, a minimum of 107 participants is required for a 3x2 contingency table ($df = 2$).[11] Using the common rule of a minimum of 10 events per independent variable in the multivariate logistic regression model,[12] and assuming a 30% event rate (medication nonadherence),[13] at least 333 chronic-medicine-taking respondents will be needed for a model that includes 10 predictors while preventing model overfitting. Given that approximately half of STDHCE clients were suffering from various chronic conditions, it was expected that at least 670 respondents would be needed for the study in order to secure a sufficiently large sub-group for the logistic regression analysis.

All statistical analyses were conducted using R (version 4.3.2).

RESULTS

Demographics

A total of 733 replies were received, of which 690 (94.1%) were members of STDHCE. Respondents aged 18 – 50, 51 – 60, 61 – 70, and 71 and above years made up 8.5%, 20.2%, 53.3%, and 18.0%, respectively. The female-to-male ratio was 2.5 (521:210, two were not disclosed). 13.9%, 50.8% and 35.3% of respondents have attained primary or below, secondary, and tertiary or above education level, respectively.

Use of Western and Complementary Medicines in the Past Year

About half of the respondents have taken three (31.8%) to four (13.8%) types of drug products listed below in the past year, signifying potential drug interactions. All descriptive findings in this section are shown in **Table 1**.

(I) Chronic medications

381 (52.0%) respondents have used chronic medications in the past year. The most commonly used drugs were for blood pressure-lowering (50.9%), lipid-lowering (47.8%), and blood glucose-lowering (17.1%). The majority of chronic medications users were taking one to two drugs only (58.5%), followed by 27.3% taking three to four drugs.

Most respondents could manage the drugs by themselves without assistance from family, domestic helper, or community health support (97.6%). Few respondents were forgetful in drug administration (3.4% for once a week; 0.3% for once a day). However, 61 (16.0%) chronic medications users have stopped taking the drugs when they felt the symptoms were under control.

Over half (57.2%) of the respondents have experienced suspected adverse reactions to drugs. Most would seek doctor's advice at the next appointment (60.9%), 11.8% and 10.5% would discontinue the drug or reduce the dose by themselves, respectively.

(II) Medications for minor ailments

658 (89.8%) respondents have used medications for minor ailments in the past year, constituting the most prevalent type of drug product among the four categories in the survey. Cold and cough medicines (79.3%), analgesics (61.9%), and proprietary Chinese medicines (43.8%) were the most frequently used products.

Respondents usually obtained these medications from the public healthcare sector (including HA and Department of Health) (48.3%), non-pharmacy physical stores (47.6%), and private doctors (46.8%). Less than a quarter obtained the drugs from community pharmacies (and that did not necessitate pharmacist consultation was received) (23.3%).

(III) Supplements

493 (67.3%) respondents have used supplements (excluding proprietary Chinese products) in the past year. Vitamins and minerals products were the most popular (70.2%), followed by products for musculoskeletal pain (36.9%) and immunity-boosting (34.5%). The most common reason to take supplements was to improve health (83.4%), followed by 38.1% who believed supplements were effective. Moreover, 22.5% and 17.6% respondents considered supplements as more natural and less toxic when compared to medicines, respectively.

Supplements were most frequently obtained from non-pharmacy physical stores (58.0%), relatives and friends (26.8%), and online stores (25.4%). Less than one-fifth were from community pharmacies (with or without advice from pharmacists) (18.1%), and even less from doctors (9.3% from public sector, 6.1% from private sector).

(IV) Chinese medicines

235 (32.1%) respondents have used traditional Chinese medicines and proprietary Chinese medicines in the past year. Most took these medicines for regulating the body homeostasis and disease prevention (75.7%). The majority of Chinese medicines used were obtained from Chinese medicine practitioners (CMP) in different practice sites, while others were obtained from pharmacies or non-pharmacy stores without CMP (23.4%), relatives and friends (14.0%), or online stores (6.0%).

Table 1. Use of medications in the past year (n=733)

	Frequency (%)
Use of chronic medications	**381**
Types of drugs used (multiple choices)	
Blood pressure-lowering drugs	194 (50.9%)
Lipid-lowering drugs	182 (47.8%)
Blood glucose-lowering drugs	65 (17.1%)
Medicines for gastric conditions	59 (15.5%)
Psychiatric medication and/or sleeping pills	53 (13.9%)
Blood thinners	51 (13.4%)
Number of chronic medications currently taking	
1 – 2 types	223 (58.5%)
3 – 4 types	104 (27.3%)
5 – 6 types	38 (10.0%)
7 – 9 types	14 (3.7%)
10 types and above	2 (0.5%)
How do you usually manage and take your medications	
Manage on my own, without help from others	372 (97.6%)
Assisted by family members	8 (2.1%)
Assisted by domestic helper/community nurse	0 (0%)
How often do you forget to take your medications	
Never	121 (31.8%)
Very rarely (about once in a few months)	182 (47.8%)
Sometimes (about once a month)	64 (16.8%)
Often (about once a week)	13 (3.4%)
Every day	1 (0.3%)

	Frequency (%)
Would you sometimes stop taking your medications when you feel the condition is under control	61 (16.0%)
Have you experienced any suspected side effects from drugs	218 (57.2%)
Handling of suspected side effects from drugs (multiple choices)	
Wait until next follow-up medical appointment with doctor	232 (60.9%)
Immediately seek advice from healthcare professionals (such as doctors, pharmacists, nurses, etc.)	139 (36.5%)
Continue taking the medication	88 (23.1%)
Stop taking the medication on your own	45 (11.8%)
Reduce the dosage on your own	40 (10.5%)
Use of Medications for Minor Ailments	**658**
Types of medications for minor ailments used (multiple choices)	
Cold and cough medicines	522 (79.3%)
Analgesics	407 (61.9%)
Proprietary Chinese medicines	288 (43.8%)
Medicines for gastrointestinal discomfort	233 (35.4%)
Anti-allergy medications	213 (32.4%)
Creams/ointments for skin problems	199 (30.2%)
Antibiotics	136 (20.7%)
Medicated patches	134 (20.4%)
Steroids	62 (9.4%)
Anti-dizziness medications	61 (9.3%)
Nasal sprays	50 (7.6%)
Sources of medications for minor ailments (multiple choices)	
Hospital Authority or Department of Health	318 (48.3%)
Other physical retail stores	313 (47.6%)
Private doctors	308 (46.8%)
Community pharmacies	153 (23.3%)
Relatives or friends	21 (3.2%)
Online shopping or other online platforms	11 (1.7%)
Use of Supplements	**493**
Types of supplements used (multiple choices)	
Vitamins and/or minerals	364 (70.2%)
Bone and joint pain relief products	182 (36.9%)
Immune-boosting/wellness products	170 (34.5%)
Eye care	138 (28.0%)
Cardiovascular protection	86 (17.4%)
Mood/sleep improvement	67 (13.6%)
Brain function/memory improvement	54 (11.0%)
Liver protection	43 (8.7%)
Skin improvement	29 (5.9%)
Detox/weight loss	23 (4.7%)
Prostate/urinary health	16 (3.2%)
Uric acid control	12 (2.4%)
Kidney protection	11 (2.2%)
Blood sugar control	8 (1.6%)
Reasons for taking supplements (multiple choices)	
To improve health	411 (83.4%)
Believe they are effective	188 (38.1%)
Recommended by relatives or friends	152 (30.8%)
Consider ingredients more natural (compared to medicines)	111 (22.5%)
Believe there are fewer side effects (compared to medicines)	87 (17.6%)
Recommended by healthcare professionals	65 (13.2%)

	Frequency (%)
Reasonable price	60 (12.2%)
Advertising	47 (9.5%)
Salesperson recommendation	15 (3.0%)
Sources of supplements (multiple choices)	
Other physical retail stores	286 (58.0%)
Relatives or friends	132 (26.8%)
Online shopping or other online platforms	125 (25.4%)
Community pharmacies	89 (18.1%)
Hospital Authority or Department of Health	46 (9.3%)
Private doctors	30 (6.1%)
Use of Chinese Medicines	**235**
Reasons for taking Chinese medicines (multiple choices)	
To regulate the body and prevent illness	178 (75.7%)
To treat occasional illnesses	85 (36.2%)
Believe there are fewer side effects (compared to Western medicines)	73 (31.1%)
Believe ingredients are more natural (compared to Western medicines)	68 (28.9%)
Believe they address the root cause (compared to Western medicines)	54 (23.0%)
Recommended by relatives or friends	51 (21.7%)
To treat chronic illnesses	33 (14.0%)
Reduce side effects of Western medicine	23 (9.8%)
Advertising	18 (7.7%)
Recommended by healthcare professionals	14 (6.0%)
Sources of Chinese Medicines (multiple choices)	
Independent CMP	80 (34.0%)
Chinese Medicine Clinics cum Training and Research Centres	64 (27.2%)
Pharmacies or non-pharmacy stores with drug supply (without CMP)	55 (23.4%)
NGO CMP	51 (21.7%)
CMP practicing in pharmacies/non-pharmacy stores with drug supply	49 (20.9%)
Relatives or friends	33 (14.0%)
Online shopping or other online platforms	14 (6.0%)
Number of types of medication taken in the past year (including chronic medicines, minor ailments, supplements, and Chinese medicines)	**733**
Not taking any medication	19 (2.6%)
One type	96 (13.1%)
Two types	284 (38.7%)
Three types	233 (31.8%)
Four types	101 (13.8%)

Abbreviations: CMP = Chinese medicine practitioners; NGO = non-governmental organizations

Treatment Beliefs

The mean scores of the Specific-Necessity and Specific-Concerns sub-scales for the full sample were 3.18 (.754) and 3.12 (.700) respectively, showing a largely neutral attitude of the respondents towards pharmacological treatment.

Health Information Literacy

The most commonly encountered questions about drugs or supplements were uncertain effectiveness (52.4%), adverse drug reactions (36.4%), and drug interactions (28.6%). Respondents usually consulted the doctors (56.5%), looked for information from the media themselves (47.7%), and asked relatives and friends (31.1%) to answer their questions. Only a quarter consulted the pharmacists (25.6%). In spite of the high prevalence of searching for health information in online platforms (90.5%), only around a quarter of the respondents rated online information platforms as useful or very useful in addressing their questions (23.7%), and reliable or very reliable (26.5%), respectively. Table 2 summarized the findings on health information literacy.

Table 2 Health information literacy (n=733)	
	Frequency (%)
Problems encountered with medications or supplements (multiple choices)	
Uncertain effectiveness	384 (52.4)
Adverse drug reactions	267 (36.4)
Drug interactions	210 (28.6)
Not following doctor's/pharmacist's instructions in using medicines	48 (6.5)
Handling of problems related to medications or supplements (multiple choices)	
Consult a doctor	414 (56.5)
Look up information through the media/online	350 (47.7)
Seek for advice from relatives/friends	228 (31.1)
Consult a pharmacist	188 (25.6)
Consult other healthcare professionals	133 (18.1)
Decide on your own	130 (17.7)
Consult a salesperson	71 (9.7)
Have searched/browsed for health information on online platform(s)[#]	**663 (90.5)**
How well health information from online platforms address your concerns? (n=663)	
Not at all able to address	17 (2.6)
Not quite able to address	72 (10.9)
Neutral / Fair	417 (62.9)
Largely able to address	146 (22.0)
Completely able to address	11 (1.7)
How reliable do you think these online health platforms are? (n=663)	
Not reliable at all	2 (0.3)
Not quite reliable	12 (1.8)
Neutral / Fair	473 (71.3)
Quite reliable	167 (25.2)
Very reliable	9 (1.4)

[#] Online platforms refer to online search engines (e.g. Google, Baidu), social media platforms (e.g. Facebook, Youtube, Instagram), health product vendor/private healthcare service websites, NGO websites, and relevant public sector websites (e.g. Hospital Authority or Department of Health websites).

Awareness, Perceived Needs, and Utilization of Community Pharmacy Services

Almost 40% of respondents were not aware of any existing CPS available. The most noticeable service was drug and health education talks (38.3%). When asked what kinds of pharmacy service respondents thought the community needed, general drug consultation was the most popular (63.3%), followed by education talks (51.8%), medication management services (MMS) (49.9%), and minor ailment management and consultation (43.9%). (Table 3)

The differences between the proportions of respondents who were aware of certain services and those who perceived a community need for them (i.e. perceived need % – awareness %) indicated substantial gaps. Positive differences suggested more respondents recognized a need for a particular service than were aware of their availability. Conversely, negative differences suggested while more respondents were aware of the service, fewer of them felt the service was needed. Table 3 illustrated large gaps between perceived need and awareness (perceived need % – awareness %) on general drug consultation (42.2%), MMS (35.3%), minor ailment management and consultation (33.3%), and drug disposal (31.1%).

Table 3. Community pharmacy services being aware of or considered a service need in the community by respondents (ranked in descending order of % differences) (n=733)

Community pharmacy services	Perceived Need	Awareness	Awareness Gap# (% differences)
General drug consultation (face-to-face and telepharmacy)	464 (63.3%)	155 (21.1%)	42.2
Medication management services	366 (49.9%)	107 (14.6%)	35.3
Minor ailment management and consultation	322 (43.9%)	78 (10.6%)	33.3
Drug disposal (including expired, excess drugs)	295 (40.2%)	67 (9.1%)	31.1
Online health information verified by pharmacist	297 (40.5%)	86 (11.7%)	28.8
Affordable drugs and health appliances supply	308 (42.0%)	104 (14.2%)	27.8
Drug and health education talk	380 (51.8%)	281 (38.3%)	13.5
Drug delivery (with pharmacist's consultation)	188 (25.6%)	128 (17.5%)	8.1
Vaccination consultation and administration	207 (28.2%)	195 (26.6%)	1.6
Smoking cessation	82 (11.2%)	142 (19.4%)	- 8.2
I don't know	68 (9.3%)	292 (39.8%)	N/A

The awareness gap is the percentage point difference calculated as (% perceived need – % awareness). A positive value indicates need exceeds awareness; a negative value indicates awareness exceeds need.

Table 4 showed the desired institutions to provide CPS and Table 5 showed the willingness-to-pay for MMS. Findings suggested that District Health Centres / Expresses were the most popular options for providing CPS reaching 87.9%. While over 60% of respondents expressed willingness to pay for MMS, almost 50% thought the service should be charged between HK$1 – 100 per hour.

Table 4. Desired institutions to provide community pharmacy services (n=733)

Institutions (multiple choices)	Frequency (%)
District Health Centres / Expresses	644 (87.9)
District Elderly Community Centres and Neighbourhood Elderly Centres	423 (57.7)
Not-for-profit community pharmacies	323 (44.1)
Large-scale retail community pharmacies	316 (43.1)
Other community pharmacies	151 (20.6)
Residential Care Homes	150 (20.5)
Non-pharmacy stores with drug supply	147 (20.1)
Integrated Community Centre for Mental Wellness	126 (17.2)

Table 5. Willingness-to-pay for medication management services (n=733)

Charge HKD/hour	Frequency (%)
Free	282 (38.5)
$1 - $50	194 (26.5)
$51 - $100	170 (23.2)
$101 - $200	69 (9.4)
$201 - $300	10 (1.4)
Above $300	8 (1.1)

Demographic Correlates of Treatment Beliefs, Health Information Literacy, and Community Pharmacy Needs

Statistically significant associations ($p<.0005$) were found between demographic characteristics and health information literacy and community pharmacy needs. Gender differences were generally minimal, except females were more likely to express needs for drug disposal services than males.

The youngest group (≤60 years old) was most likely to look up information from the media/online sources to address drugs/supplements-related questions, compared to the older counterparts (vs. 61-70 and >71 years old). This group also consistently demonstrated greater awareness of specific community pharmacy service (i.e. smoking cessation), expressed significantly higher needs for certain CPS (minor ailment management and consultation, smoking cessation, and drug delivery).

A consistent trend was also observed across education levels. Respondents with tertiary education or higher were most likely to have encountered problems related to adverse drug reactions, looked up information through the media/online sources to handle drugs/supplements-related questions, had greater knowledge of a variety of CPS (drug and health education talk, vaccine consultation and administration, and drug delivery), expressed higher needs for a range of CPS (general drug consultation, minor ailment management and consultation, online health information verified by pharmacist, affordable drugs and health appliances supply, drug disposal, and drug delivery). Respondents from the primary or lower education group had a significantly higher proportion of "don't know" responses (24.5%) when asked about the perceived needs for CPS, compared to those with secondary education (7.3%) and tertiary or above (6.2%).

There was no significant (p>.0005) correlation between any sociodemographic characteristics and treatment beliefs (Specific-Necessity and Specific-Concerns), and willingness-to-pay.

Predictors of Medication Nonadherence Among the Chronically Ill

Among patients taking chronic medications, the event rate of medication nonadherence (stop taking medicines when felt symptoms were under control) was 16.0%. Univariate analysis identified that experience with drug side effects, use of supplements (apart from chronic drugs), and concern towards medications for personal use (measured by BMQ Specific-Concerns) were statistically different between the adherence group and the nonadherence group (p<.05). These three predictors, along with the three sociodemographic variables (gender, age, and education) were included in the final multivariate logistic regression model as covariates.

The final multivariate model showed that the odds of medication nonadherence were significantly higher for respondents with greater concern about their treatment (BMQ Specific-Concerns: adjusted OR = 1.16 per point, p = 0.020), those using supplements (adjusted OR = 2.70, p = 0.006), and those experienced side effects (adjusted OR = 1.99, p = 0.046). Conversely, female respondents reduced the odds of medication nonadherence by 47% (adjusted OR = 0.53, p = 0.041).

DISCUSSION

Findings of the survey on medication management and CPS utilization of Sha Tin residents showed that considerable respondents reported challenges in medication management, from inadequately answered questions about their drugs to inappropriate side effects management and nonadherence. Nonetheless, consistent and reliable support from healthcare professionals, particularly pharmacists, was either insufficient or being overlooked, as illustrated by the significant gap between pharmacy services that were being aware of and those needed in the community.

Respondents taking chronic medications demonstrated good drug adherence in general. 97.6% could manage the drugs by themselves and 79.5% never or very rarely forgot to take drugs. This could possibly be attributed to the relatively simple drug regimen of respondents as 85.8% of them were taking four or less chronic medications a day. The prevalence of medication nonadherence among chronically-ill respondents in this study was lower than previously reported local rates (16.0% in current study vs. 37% among elderly patients with chronic diseases vs. 45% among hypertensive patients vs. 61.6% among hidden elderly), but higher than 9.2% reported among community-dwelling elderly in another local study.[13-16]. Possible reasons for these differences could be attributable to variations in sociodemographic factors, level of social support (e.g. lower in hidden elderly while higher among STDHCE members who remain actively engaged in the community), and potential social desirability bias. In the present survey, respondents with greater treatment concerns and those have experienced suspected side effects from drugs were more likely to be nonadherent. Almost 60% of chronic patients have experienced suspected side effects, but they were not always properly handled, as some would reduce the dose or stop taking the drugs themselves. Managing patient expectations at drug initiation by stressing on continuous drug administration for chronic disease control and complications prevention, informing potential side effects and their incidence, suggesting appropriate side effects management including seeking doctors or pharmacists to establish causality before regimen adjustment, are the key to enhancing drug adherence.

Respondents showed poor knowledge on existing CPS, particularly those who were older and/or had lower educational attainment. Moreover, a mismatch in understanding on the roles of community pharmacists was reflected from the survey. For instance, while pharmacists emphasize on their accessibility for general consultation and minor ailment management in the community,[1] only 21.1% and 10.6% of respondents were aware of these services. On the other hand, 26.6% of respondents were aware of vaccination consultation and administration as a community pharmacy service, the second highest of all; yet, the extent of structured vaccination training for practicing pharmacists in HK is currently limited and the service is underdeveloped.[17] Effective promotion strategies are essential

to raise public awareness on the range of CPS. While the survey showed that online media generally appeal to the young and middle-aged adults, traditional media such as newspapers and television broadcast could better reach the elderly, who are generally more comorbid and have higher incidence of polypharmacy, thus requiring more community support. CPS providers should leverage community organizations including elderly centres, day care centres, patient groups, District Health Centres/Expresses, and District Services and Community Care Teams, to expand their impact to the needy. In addition to marketing tactics, providing impactful and quality services to imprint a positive image of "community pharmacies" and "community pharmacists" in citizens is even more important.

In the era of information explosion, pharmacists must keep abreast of clinical knowledge to provide evidence-based advice to citizens and other healthcare professionals. With the increasing prevalence of artificial intelligence tools among both the public and professionals, analytical skills and clinical thinking skills of pharmacists become exceptionally significant to provide valid and tailored advice to individuals. A local study targeted at adults attending primary care clinics showed that among roughly 70% of respondents who have searched drug information by internet, 52.9% and 36.0% strongly agreed/agreed that the information was useful and reliable, respectively. The rates were much higher than the present study (23.7% and 26.5% respectively).[18] Nurturing analytical and critical thinking skills in laymen when facing medical information is increasingly important nowadays as the media is flooded with both accurate and misleading information.[19,20] Relevant skills include identifying reliable sources of information (such as officially published documents), differentiating facts, objective and unbiased data from opinions and subjective preference of "Key Opinion Leaders" who do not necessarily have any relevant professional qualifications in the fields they are commenting on.

The hourly wage of community pharmacists in Hong Kong is roughly HK$300.[21] The monthly salary approximates to Point 25 (around HK$56,000) of the Master Pay Scale of the HKSAR Government and the entry point of Pharmacist-grade staff in the Hospital Authority (around HK$61,000, HA General Pay Scales Point 25).[22,23] MMS sessions last for around one hour at initial meeting, in addition to time spent on case preparation and documentation. Pharmacists could not perform drug dispensing while providing MMS, thus forgoing income generated from product sales, although they do not earn dispensing fee either, at present. The common practice of providing MMS free-of-charge is undoubtedly unsustainable without funding support. Recent Public Healthcare Fees and Charges Reform put forward by the Health Bureau and Health Authority in March 2025 has sparked public debates as the charges of services provided by the Hospital Authority would be increased, some by one-fold or more, from January 2026 onwards, but still lower than private medical charges.(24) This paves the way for introducing service charges to pharmacy services in primary care setting when public acceptance to pay for healthcare service at reasonable price increases. In the present survey, only 2.5% of respondents were willing to pay HK$201 or above per hour of MMS. To promote CPS development and accessibility, providing financial incentives to CPS providers is crucial. For instance, providing dispensing fees for dispensing of chronic medications with pharmacist counselling and reimbursement for MMS at community pharmacies could offload HA for clinical services and complex cases management in hospitals; subsidized vaccination by pharmacists could help to increase accessibility, prevent disease outbreak, and reduce public health burden.

Government policies are implemented with multiple considerations including public needs priority, relative impact on public health, effective use of resources, and balance of interests of different stakeholders. As a result, the policies may not be exactly congruent with citizens' will as individual citizens mostly focus on personal and family needs without big data analyses on overall societal impact. However, with funders support, community parties could initiate pilot projects in smaller scales for specific target groups. With proven public health and societal impact such as effectiveness in disease or complications prevention and cost-effective use of healthcare and social resources, the projects could be proposed to the government and scale-up implementation at population level. This "bottom-up" approach is observed in current MMS and residential care home (RCH) drug management services implemented by CPS providers which have provided invaluable experience for the upcoming Community Pharmacy Programme (Co-Care and RCH models) to be launched by the government next year.[25,26] Furthermore, the arrangement to reduce dispensing quantity to patients in the Hospital Authority starting from March 2025 is supported by previous and ongoing initiatives by community pharmacies to collect unused drugs from the general public for proper disposal to reduce drug wastage and environmental harm.(27-30) Service providers should be sensitive to public needs and innovative in service planning to gain government buy-in and serve a greater community.

LIMITATION

First, most respondents in the survey were members of STDHCE. STDHCE focuses on preventive care, thus members are generally mobile with few comorbidities or medical complications. Citizens who join STDHCE also have higher health awareness than the average population and of middle-old age. These would limit the generalizability of the survey findings to residents in Sha Tin district and the Hong Kong territory. In addition, the questionnaire was self-administered online, thus indirectly excluded those with lower technology literacy. Nonetheless, the survey could be a readily adopted means to engage the public in CPS development, and publication of survey findings provides a basis for pharmacy service providers in service planning, as well as an example for providers in other settings to enhance public participation.

CONCLUSION

Healthcare professionals as service providers formulate service development based on their observed community needs and institutional considerations. On the other hand, citizens

as service users give honest feedback on how well existing services can address their needs, if they are given the channel to express their opinions. In the future, the public should be invited to be engaged in more population and district-based studies and open discussions on medication management and community pharmacy services to enable policy makers and service providers to direct service development and resources to meet local needs.

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Public Forum on Medication Management of Citizens and Community Pharmacy Services in Hong Kong

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ABSTRACT

The Sha Tin District Health Centre Express has conducted a survey in early 2024 to study the medication management and utilization of community pharmacy services by local residents in Sha Tin to formulate pharmacy services that address community needs. The results showed that citizens faced problems in medication management such as inappropriate side effects management and nonadherence, low awareness of community pharmacy services, and service gap that falls short of public expectation. Subsequently, a public forum was held in March 2025 with pharmacists, doctors, and the general public to discuss situations reflected from survey findings and commonly encountered problems faced by citizens. Conceptualizing the term "community pharmacy" was one of the major foci of the general public, along with other pharmacy service needs, which was consistent with recent government initiatives. Concerted efforts of different healthcare professionals and service providers are vital to holistic and continuous healthcare services provision. Citizens should be involved in the planning of primary healthcare and community pharmacy services.

Keywords: *Primary healthcare, Community pharmacy, Community pharmacist, Medication management, Public engagement*

INTRODUCTION

In the past few years, significant progress in the development of community pharmacy services (CPS) in Hong Kong has been driven by the growing establishment of non-governmental organization (NGO) community pharmacies with new service models such as the Jockey Club PHARM+ Community Medication Service Network Project, the COVID-19 pandemic which accelerated telepharmacy and medication delivery services, and the HKSAR Government support as put forward by the Primary Healthcare Blueprint in 2022, which has laid down the directions of community pharmacy development and showed recognition of the roles of community pharmacists and other healthcare professionals such as allied health.[1-4] The Chief Executive's Policy Address in October 2024 and September 2025 have again shown the determination of the HKSAR Government in developing CPS in Hong Kong by setting the timeline of rolling out the Community Pharmacy Programme, first phase in Q4 2026.[5,6] One month after the Policy Address 2025 was released, the Community Drug Formulary mechanism and Guidelines of Practice for Community Pharmacy were promulgated by the Primary Healthcare Commission.[7]

Understanding the needs of the population is vital to develop impactful services that cater for community needs. In spite of the progress made by local community pharmacy service providers, data on citizens giving "their say" on what they need is scarce. Therefore, the Sha Tin District Health Centre Express (STDHCE) has conducted an anonymous survey from March to May 2024 to understand the medication management practice and utilization of CPS by Sha Tin residents, and explore further pharmacy service development.[8] A total of 733 responses were received and the results showed potential drug related problems including inappropriate side effects management and nonadherence. Respondents also showed low awareness of CPS, and service gaps between known services and perceived community needs.

Based on the survey findings, a public forum "相藥在沙田－談社區藥劑服務論壇" was held in March 2025 to further raise public awareness and spark discussion on medication management by the public and CPS. This article summarizes discussions and findings from the forum.

EVENT OVERVIEW

The event was held on 15 March 2025 at the Heung Yee Kuk Building in Sha Tin. It attracted 168 attendees, including 154 general citizens (140 (90.9%) were members of STDHCE) and 14 representatives from the medical-social sector (pharmacists, doctors, and representatives from District Services and Community Care Teams).

The event started with a summary presentation on the pharmacy survey findings, followed by one-hour discussion with guest speakers based on the survey, and a 30-minute question-and-answer session inviting questions from the floor.

Four guest speakers were invited to share their opinions on stage:

- Dr. Carl Wong (Family Medicine Doctor), Medical Consultant, Sha Tin District Health Centre Express

- Dr. Joyce Ching (Family Medicine Doctor), Chairman, Health In Action, which operates the Health In Action Community Pharmacy
- Mr. Marco Lee (Pharmacist), Senior Pharmacist (Primary Care Services Development Manager), Department of Pharmacology and Pharmacy, The University of Hong Kong
- Mr. Philip Chiu (Pharmacist), Head of Professional Service, Mannings, DFI Retail Group

The discussion focused on six major aspects: (1) demand for CPS; (2) chronic disease and drug management; (3) minor ailment management; (4) supplements, traditional Chinese medicines, and health literacy; (5) other CPS needs; and (6) sustainability of CPS.

***Photo 1**. Public participation in the pharmacy forum "相藥在沙田 – 談社區藥劑服務論壇"*

***Photo 2**. Invited speakers sharing on stage*

FORUM DISCUSSION FINDINGS

Community Pharmacy Service Demand

- According to the survey, 39.8% respondents were not aware of any CPS in Hong Kong. The most noticeable service was drug and health education talks (38.3%).[8]
- Community pharmacy service has transformed from dispensing-oriented to service-oriented in the past few years, such as the availability of structured and documented minor ailment and medication management services.
- Increasing the variety and quality of CPS is the key to raising public awareness.

Chronic Disease and Drug Management

- The survey showed that 16.0% of chronic medications users would stop taking their medicines when the symptoms were under control. Furthermore, 57.2% of chronic patients have experienced suspected adverse reactions to drugs, and 11.8% and 10.5% would discontinue the drug or reduce the dose by themselves, respectively. Only 14.6% of total respondents were aware of medication management services (MMS) in the community but 49.9% considered MMS as a community need.[8]
- MMS comprise a detailed, patient-centered review on the appropriateness, effectiveness, safety, and adherence of medication therapy between pharmacist and the patient (and/or caregiver) to improve health outcomes. This level of high-intensity intervention differs from a general drug consultation on simple questions such as side effects or administration method of a drug, thus would be more useful in complex cases such as polypharmacy and changes in drug regimen.
- Pharmacists would arrange follow-up appointments to monitor the drug management and health outcomes of patients, and refer to other healthcare professionals (e.g. family doctors, dietitians, physiotherapists) as needed to ensure holistic patient care.

Minor Ailment Management

- 89.8% of survey respondents have taken medications for minor ailments in the past year, constituting the most common type of drug product taken (compared to chronic medications, supplements, and Chinese medicines). The medications were most frequently obtained from public and private doctors, as well as non-pharmacy stores with drug supply (around 50% respondents for each), while less than a quarter were from pharmacies (which did not necessarily imply clients received pharmacist consultation as well).[8]
- The general public do not always know how to evaluate the severity of their symptoms and would self-medicate without proper guidance while delaying appropriate management of their apparent "minor ailments". Citizens often face obstacles in booking General Out-patient Clinic appointments in the Hospital Authority (HA) and have financial concerns to visit private general practitioners, especially for the underprivileged.
- Registered pharmacists in the community are readily accessible in different districts and locations, providing non-appointment-based and free-of-charge consultations on minor ailments. Pharmacists are trained to evaluate and provide pharmacological and nonpharmacological advice to handle minor ailments, and refer patients to doctors when red flags are identified.

- Citizens were suggested to maintain a record of previous medications tried to treat their conditions to facilitate assessment by pharmacists and doctors.

Supplements, Traditional Chinese Medicines and Health Literacy

- 67.3% of survey respondents have taken supplements in the past year, constituting the second most common type of drug product taken. The products were mostly self-purchased from non-pharmacy physical (58.0%) and online (25.4%) retail stores, and also obtained from relatives or friends (26.8%).[8]
- Supplements are generally used without robust evidence, but widely popular among the general public due to perceived "naturality" and "less toxicity" than conventional treatment.
- Citizens were advised to choose supplements with relatively more evidence and consider the economic value before purchasing the products. Other than supplements, lifestyle modification could be another means of improving health.
- The general public was encouraged to ask the right persons (trained healthcare professionals in the specialized area, such as pharmacists about drugs) and seek from the right platforms (reliable media and websites) for medical advice.

Other Community Pharmacy Service Needs

- Affordable drugs and health management products in the community was known by 14.2% of respondents and perceived as community need by 42.0%.[8] Promoting the use of generic drugs under suitable circumstances and expanding brand variety of products in the locality could bring-in competitions, reduce product prices and increase users' affordability. The establishment of more community pharmacies in different locations could further enhance geographical accessibility to meet the health needs of citizens.
- Drug disposal service was known by 9.1% of respondents and perceived as community need by 40.2%.[8] Currently, there is no official guidance on proper disposal of unserviceable, expired, or excess drugs in households, endangering the environment and human health. Drug waste handling campaigns organized in the past few years by community parties were all one-off basis and of limited time period due to the significant manpower and financial costs involved. Citizens were encouraged to reduce drug wastage by requesting a smaller quantity of drugs to be taken on as needed basis, and improving drug adherence with professional support.
- Drug delivery service was known by 17.5% of respondents and perceived as community need by 25.6%.[8] Setting up dispensing outlets of drugs from the Hospital Authority to community pharmacies could enhance convenience to patients and raise public awareness on the roles of community pharmacists. Nonetheless, constraints in pharmacy set-up, including hardware (e.g. space for drug storage and private consultation) and software (e.g. IT system interface and communications with HA), and striking a balance between maintaining high service standards and meeting the high output levels anticipated (given the large volume of cases in HA) were the major concerns from the angle of community pharmacy operators.

Sustainability of Community Pharmacy Services

- In the survey, 38.5% hoped for free MMS, while 26.5%, and 23.2% were willing to pay for $1-50 and $51-100 per hour, respectively.[8]
- Copayment model (as in the Chronic Disease Co-Care Pilot Scheme launched in November by the Health Bureau to subsidize Hong Kong residents to screen and manage hypertension, diabetes, and hyperlipidemia in the private medical sector) and medical insurance schemes (Voluntary Health Insurance Scheme implemented by the Health Bureau in April 2019 to regulate indemnity hospital insurance plans for individuals) put forward by the government could be some ways to finance CPS, of which most are provided free-of-charge currently (e.g. no dispensing fee, free general consultation and pharmaceutical services such as MMS).[9,10]
- Preliminary findings from a survey about patient satisfaction on minor ailment service provided by pharmacists showed that majority of patients need not further seek for consultations from other healthcare professionals (such as doctors) after the pharmacist encounter, in turn helped to save potential additional medical costs incurred. (verbally reported by one speaker)
- Citizens were encouraged to take personal responsibility for their health, and were reminded that quality services by pharmacists were valuable and should be appreciated with reasonable payment.

PUBLIC DISCUSSION

Participants were enthusiastic in the question-and-answer session, showing active public participation in the matter being discussed. Citizens were most interested in the definition, scope, and practice of "community pharmacy" (社區藥房). Speakers in the forum and STDHCE further elaborated on modes of existing pharmacy practices to address public enquiries. Issues on information sharing in the Electronic Health Record Sharing System by healthcare professionals in non-governmental bodies such as private practice, refill of drugs from HA at community pharmacies in case of drug shortage, and post-discharge follow-up at the primary healthcare setting were also of interest to citizens. These questions have not been specifically covered in the pharmacy survey as well as the forum, demonstrating the effect of "pooling the wisdom" from different people, particularly the general public, in driving service development and the importance of prioritizing service needs.

POST-EVENT EVALUATION

The post-event participant feedback survey received a total of 87 replies, including 81 from the general public and 6 from representatives of the medical-social sector. Respondents rated positively on all scores (mean scores) including enhanced understanding on medication management of citizens (public: 3.9/5, industry: 4.3/5), existing CPS (public: 3.8/5, industry; 4.5/5), reflection on personal health management and use of CPS (public: 3.8/5), understanding on public expectations on CPS (industry: 4.5/5) and future CPS planning (industry: 4.3/5). Respondents largely agreed (public: 4.2/5, industry: 4.3/5) to extend the medication management and CPS survey to Hong Kong territory-wide.

Similar to the question-and-answer session, some participants further enquired on the definition and concept of "community pharmacy" in the post-event evaluation form. In-house pharmacist in STDHCE provided further explanation to individual citizens based on their personal experience and needs. Some participants from the industry suggested to provide more case sharing as illustration and involve more stakeholders or different age groups of the general public. Of note, the event was open to all regardless of background including age, place of residence, and job, and these data were not collected from the general public (only organization names and job titles were collected from representatives of the industry). Nevertheless, involvement of a wider range of participants could potentially contribute to expanded aspects of discussion.

DISCUSSION

The public forum demonstrated that CPS have shifted from mainly dispensing medications to offering a wider range of patient-centered care. Pharmacists are now playing a more active role in both chronic disease and minor ailments management. There is a growing public demand for affordable medicines and health appliances supply as well as drug disposal service. On the other hand, service providers need policy, infrastructural and technological support to provide diversified and sustainable services.

Since the establishment of the first NGO community pharmacy in 2009,[11] the functions of community pharmacy have gradually shifted from drug dispensing and general face-to-face consultations to a wide range of services such as subsidized drugs supply, travel packs, structured MMS and minor ailment management service, outreach and home visits. Currently, there are nearly 30 NGO community pharmacies serving communities in 17 districts (none in Island District) in HK, driving the development of pharmacist-led primary healthcare services development.[12] On the other hand, chain pharmacies have the advantage of implementing coordinated district-wide pharmacy services such as drug delivery and drug disposal services.[3,13,14] There are around 130 chain pharmacies in HK, of which two groups have pharmacies in all 18 districts.[12]

The survey on which the forum was based on revealed gaps in CPS provision, including differences between services known and those perceived as community needs by citizens, and also divergent understanding on the roles of community pharmacies by pharmacists themselves and the general public.[8] Other than the use of effective promotion strategies, enhancing transparency of services provided by different pharmacies, as reflected by the abundance of citizens asking "what is community pharmacy", is highly important for citizens to better utilize CPS in their health management. A local group of young pharmacists have developed an online map enabling citizens to search for pharmacists with prescription dispensing, minor ailment management, or general consultation services at different districts.[15] The inclusion of pharmacists in the Primary Care Directory will be a step forward to categorize and formalize pharmacy services officially, and a means for general public to seek assistance from community pharmacists readily.[16] Training on pharmacist-led primary healthcare services in local Bachelor of Pharmacy and postgraduate continuous professional education programmes are crucial to nurture sufficient competent pharmacists in the primary healthcare setting, thus extend the scope, accessibility, and impact of CPS.

The term "community pharmacy" has been a confusion among both outsiders and insiders of the pharmacy industry as the law, Cap. 138 Pharmacy and Poisons Ordinance, has only defined "Authorized Seller of Poisons" (ASP; also called "pharmacy", "dispensary", "drug-store", or "藥房" in Chinese), but not "community pharmacy".[17] While ASPs could generally be regarded as "community pharmacies", in contrast to "hospital/clinic pharmacies" as shown by the diverging ways they are regulated by law, debates revolving the scope and practice of "community pharmacies" that do serve community needs arise within the industry. With the formulation of the Guideline of Practice for Community Pharmacy by the Primary Healthcare Commission and implementation of the Community Pharmacy Programme, the concept of "community pharmacy" would be clarified to the industry, other healthcare workers, and the general public.[7] And while the society is in a heated discussion about "community pharmacy", community pharmacists working outside of the pharmacy, such as those providing MMS and system-level medication management support to residential care homes, pharmacists working in primary care clinics, pharmacy informatics, and those in the District Health Centres/Expresses, also play important roles in contributing to CPS development (社區藥劑服務發展 vs. 社區藥房服務發展).

Public engagement in service planning could raise public awareness and curiosity on the matter, stimulate questions from citizens to understand further about CPS, and through self-reflection, improve personal and family health management. At the same time, service providers and policy makers could understand public needs, mobilize resources more effectively, and gain public support when implementing new services. Clear explanations on the rationale of programmes and services, prioritization of public needs to cater for, and challenges in implementation by policy makers could provoke public discussion and generate potential solutions by the effect

of "pooling wisdom" from different parties. Adopting an open-minded attitude to collect continuous feedback from service users could facilitate service enhancement.

As the functions of community pharmacies become more service-oriented, it is possible that they generate less income because most services are not paid for or charged at very low prices that barely cover costs. The phenomenon is apparent that most NGO pharmacies as pioneers of many CPS rely on fundings to support their services, which are free or undercharged to increase public acceptance and participation rate. Conversely, independent and chain pharmacies rely on product sales, including both pharmaceutical products and other commodities such as tissue papers, beauty products, and health food and supplements, to cover costs and generate income as self-financing companies.[18] Service providers should receive considerable financial gains as an incentive to implement further services. Different reimbursement models for CPS, including dispensing and cognitive pharmaceutical services that utilize the expertise of pharmacists to optimize pharmacotherapy, have been adopted in different countries, such as fee-for-service, capitation, patient co-payment, and universal public health insurance.[19] Hong Kong can learn from the experience of other countries in developing sustainable CPS models for itself. The healthcare reform announced by the government in March 2025 is not only about raising charges in the Hospital Authority, but also enhancing private healthcare fee transparency and exploring the feasibility of devising service standards for public and private healthcare sectors.[20,21] With a general improvement in quality of healthcare services in HK, it is anticipated that citizens would gradually adapt to paying for services of worth.

Given the escalating development of CPS, this is the golden era of community pharmacy and pharmacist service development in the locality that everyone, including pharmacists in all sectors, other medical and social professionals and institutions, public and private medical and nonmedical institutions (e.g. information technology and insurance industries), and most importantly the general public, should take an active role to be involved.

CONCLUSION

Service providers of different professional backgrounds and sectors must work together to provide accessible and comprehensive care, empower citizens to improve their health as well as disease and medication management. Public engagement by different means such as survey and forum should be encouraged to guide and prioritize service development that cater for local needs.

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Artificial Intelligence in the Pharmaceutical Industry: Understanding Transformers and Large Language Model Agents for Hong Kong Pharmacists

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INTRODUCTION

Artificial Intelligence (AI) has fundamentally transformed numerous industries, and the pharmaceutical sector is no exception. As Hong Kong pharmacists navigate an increasingly complex regulatory landscape, understanding AI technologies—particularly large language models (LLMs) and their underlying transformer architecture—becomes crucial for staying competitive and compliant in the pharmaceutical industry[1]. This article provides an accessible introduction to transformer mechanisms in LLMs and explores their revolutionary applications as autonomous agents in the pharmaceutical industry.

UNDERSTANDING LARGE LANGUAGE MODELS AND THE TRANSFORMER ARCHITECTURE

What Are Large Language Models?

LLMs are sophisticated AI systems designed to understand and generate human-like text by learning from vast amounts of textual data[2]. These models, such as GPT-4 and Claude, have demonstrated remarkable capabilities in processing complex language tasks, making them invaluable tools for pharmaceutical applications where precision in documentation and communication is paramount.

The Foundation: Transformer Neural Networks

At the heart of modern LLMs lies the transformer architecture, a revolutionary neural network design that has transformed how AI systems process information[3]. Unlike traditional neural networks that process information sequentially, transformers can analyze entire sequences simultaneously, making them exceptionally efficient for language-related tasks.

The Self-Attention Mechanism: The Core Innovation

The transformer's most significant innovation is the **self-attention mechanism**[3]. Think of attention as a spotlight that helps the model determine which parts of the input text are most relevant when processing a specific word or phrase. For example, when analyzing the sentence "The drug showed efficacy in patients with diabetes," the attention mechanism helps the model understand that "drug" and "efficacy" are closely related, even though they appear at different positions in the sentence[3]. The self-attention mechanism works through three key components:

1. **Query (Q)**: Represents what the model is currently focusing on
2. **Key (K)**: Represents all available information in the sequence
3. **Value (V)**: Contains the actual content to be processed

The model calculates attention scores by comparing queries with keys, determining how much attention to pay to each part of the input when processing specific elements[3].

Positional Encoding: Understanding Context

Since transformers process all input simultaneously rather than sequentially, they require a mechanism to understand word order and position. Positional encoding provides this capability by adding position-specific information to each word, ensuring the model understands that "The patient received the drug" conveys a different meaning than "The drug received the patient"[3].

HOW TRANSFORMERS PROCESS PHARMACEUTICAL DOCUMENTATION

When a transformer-based LLM processes a document, it follows these key steps:

1. **Tokenization**: Breaking down text into manageable units (words, subwords, or characters)
2. **Embedding**: Converting tokens into numerical representations
3. **Attention Computation**: Identifying relationships between different parts of the document
4. **Layer Processing**: Multiple transformer layers progressively refine understanding
5. **Output Generation**: Producing relevant responses or analyses

This architecture makes transformers particularly effective for pharmaceutical applications because they can:

- Simultaneously consider multiple sections of lengthy documents
- Identify complex relationships between safety data, efficacy results and requirements
- Maintain context across hundreds of pages of documentation

LLM AGENTS: THE NEXT EVOLUTION IN THE PHARMACEUTICAL INDUSTRY

From Passive Tools to Active Agents

While traditional AI systems require explicit instructions for each task, **LLM agents** represent a paradigm shift toward autonomous operation[4][5]. These agents can reason, plan, and execute complex workflows independently, making them ideal for the multifaceted challenges in the pharmaceutical industry.
An LLM agent differs from a standard LLM in several key ways:

- **Autonomy**: Agents can operate independently with minimal human intervention
- **Tool Integration**: They can access and utilize external databases, APIs, and software systems
- **Multi-step Reasoning**: Agents can break down complex tasks into manageable subtasks
- **Adaptive Learning**: They can adjust their approach based on feedback and changing conditions

APPLICATIONS IN THE PHARMACEUTICAL INDUSTRY

1. Regulatory Submission Preparation and Review

LLM agents can revolutionize the preparation of regulatory submissions by:

Cross-Reference Verification: These agents can automatically verify that information remains consistent across different sections of a submission, identifying discrepancies that might otherwise go unnoticed[6].

Regulatory Intelligence: Agents can continuously monitor regulatory guidance updates from agencies like the FDA, EMA, and Hong Kong's Department of Health, automatically flagging changes that might impact ongoing or planned submissions**[7]**.

2. Compliance Monitoring and Quality Assurance

Real-time Compliance Tracking: LLM agents can monitor pharmaceutical operations continuously, identifying potential compliance issues before they become violations[8]. They can track changes in manufacturing processes, supplier qualifications, and quality control procedures against regulatory requirements.

Automated Adverse Event Reporting: Agents can process safety data from multiple sources, automatically identifying reportable adverse events and generating preliminary safety reports in compliance with pharmacovigilance requirements[6].

3. Stakeholder Communication and Training

Automated Correspondence: LLM agents can draft responses to regulatory queries, prepare meeting minutes, and generate status reports for internal and external stakeholders.
Training Material Development: Agents can create customized training materials for different teams, ensuring staff remain current with evolving regulatory requirements and best practices[8][6].

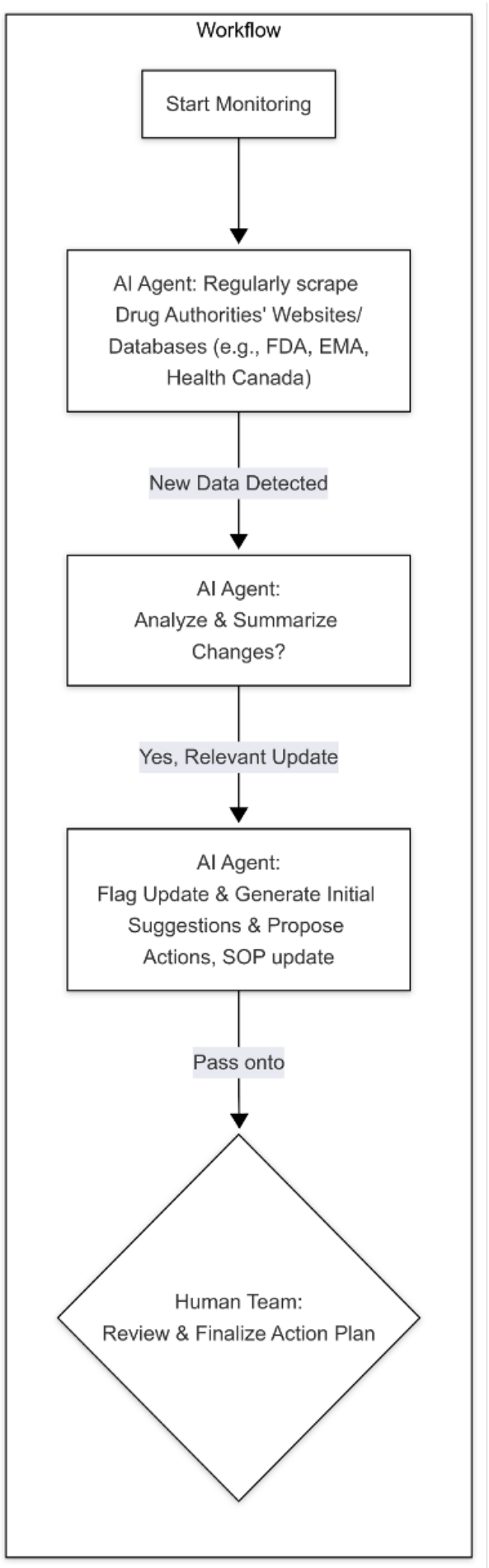

***Figure 1**: Possible agentic workflow in a pharmaceutical company*

Training Material Development: Agents can create customized training materials for different teams, ensuring staff remain current with evolving regulatory requirements and best practices[8][6].

GLOBAL EXPERIENCES: LLMs IN REGULATORY SUBMISSIONS

The use of LLMs in preparing pharmaceutical regulatory submissions overseas is moving rapidly from the experimental to the actual implementation phase, driven by the need for greater efficiency in managing vast amounts of regulatory documentation[9].

Document Drafting and Generation

Companies are using commercial LLMs (like specialized versions of GPT-4 or Gemini) to generate draft sections of regulatory submissions, such as initial versions of risk analyses, standard operating procedures (SOPs), and components of the Common Technical Document (CTD), particularly in non-clinical or administrative sections[9]. This includes drafting high-quality language for reports and compliance documents, which human experts then review and refine the "human-in-the-loop" approach[9][10].

Information Retrieval and Summarization

LLMs are used for rapidly summarizing extensive regulatory guidance, literature reviews, and clinical trial data. Specialized LLM-based tools can parse health authority guidelines to answer targeted compliance queries, significantly reducing research time for regulatory affairs professionals[10]. The EMA itself has introduced an AI-enabled knowledge mining tool, Scientific Explorer, for European Union (EU) regulators to facilitate quick, focused searching of regulatory scientific information[11].

Benefits

LLMs excel at processing and generating human-like text, which drastically accelerates the preparation of vast documentation required for submissions. For instance, they can draft high-quality initial sections of the CTD, such as administrative summaries, risk analyses, and SOPs. Furthermore, their capability for rapid summarization and targeted information retrieval from extensive regulatory guidelines and scientific literature cuts down the time regulatory affairs professionals spend on research, allowing them to focus on strategic review and critical analysis[12]. This is evident in tools developed by regulatory bodies like the EMA's Scientific Explorer, which leverages AI for knowledge mining to support faster regulatory decision-making[11].

Shortfalls

Despite the notable benefits, several critical shortfalls or challenges must be addressed for the safe and compliant use of LLMs in this highly regulated domain[13]. The primary concern is LLM "hallucination," where the models generate factually incorrect or nonsensical, yet plausible-sounding, information. This poses a significant risk if included in a submission concerning patient safety or product efficacy. Another major shortfall involves data quality and integration. LLMs are trained on enormous, diverse datasets of varying quality and provenance, making it difficult to guarantee their output is grounded in accurate, up-to-date, and jurisdiction-specific regulatory intelligence[13]. Closely related are issues of privacy and security, as general-purpose LLMs risk non-compliance with stringent data protection laws by potentially learning or exposing sensitive corporate or patient data during interaction. Finally, regulatory validation is complex because the proprietary nature of LLMs makes it challenging to provide regulatory agencies with the necessary transparency into how the model was built, trained, and verified, hindering the ability to perform robust quality assurance[14].

Resolutions

To address these shortfalls, regulatory bodies and the pharmaceutical industry are implementing targeted resolutions. The most critical resolution is the mandatory "human-in-the-loop" approach, where all LLM-generated content must be critically reviewed, cross-checked, and validated by qualified regulatory affairs professionals before submission[15]. To mitigate data quality and provenance issues, companies are moving towards developing and using curated, domain-specific LLMs trained exclusively on verified, high-quality, and proprietary internal data alongside certified regulatory texts[14]. Privacy and security concerns are addressed by using secure, enterprise-grade LLM platforms that offer robust data encryption, granular access controls, and strict adherence to data governance policies, ensuring sensitive input data is not used for model retraining. Furthermore, jurisdictions are developing risk-based regulatory frameworks to assess and validate AI/LLM tools, focusing on criteria like transparency, the quality of the training data, and continuous post-market monitoring, rather than demanding full model transparency[16].

HOW HONG KONG CAN LEARN FROM OTHER REGULATORY JURISDICTIONS

As Hong Kong moves towards establishing its own Centre for Medical Products Regulation (CMPR) and a "primary evaluation" approval pathway, it can learn from the experience of jurisdictions like the EMA and FDA.

Prioritize Regulatory Capacity Building

Following the lead of the EMA and FDA, Hong Kong must invest heavily in upskilling its regulatory staff in AI and LLMs to effectively review and assess AI-driven submissions. This includes establishing specialized AI-focused teams and continuous training[17].

Adopt a Risk-Based, Phased Approach

As the EMA's initial LLM guidance focuses on internal administrative tasks and the EU's AI Act is being phased in, Hong Kong should start by defining a clear, low-risk scope for LLM use (e.g., initial drafting, summarization) and then

gradually expand to higher-risk areas, always maintaining human oversight and a strong focus on validation.

Develop Clear Guiding Principles

The CMPR should quickly develop and publish guiding principles for both industry and its internal staff on the safe, responsible, and ethical use of LLMs, explicitly addressing issues like hallucination mitigation, data provenance, and the requirement for critical cross-checking of all LLM outputs (EMA's guiding principles are an excellent reference)[9].

Emphasize Data Standards and Interoperability

Hong Kong's shift towards a data-driven regulatory model (moving away from solely document-driven submissions) should align with international standardization efforts, such as the eCTD and the International Council for Harmonisation (ICH) frameworks. This will ensure data is machine-readable and ready for future AI/LLM applications, facilitating international recognition of Hong Kong's regulatory processes[18].

Focus on Regulatory Sandboxes

Implement regulatory "sandboxes" or pilot programs to test and refine governance frameworks for AI/LLM tools in a real-world, controlled setting before broad application[19].

RECOMMENDATIONS FOR HONG KONG PHARMACISTS

Education and Training: Hong Kong pharmacists should proactively engage in specialized AI literacy programs. These programs should not only cover the foundational understanding of transformer-based LLMs and their pharmaceutical applications but also critically address their inherent limitations, such as the potential for 'hallucinations' and algorithmic biases, which are paramount for patient safety in medication management. Training should leverage local resources like the Hong Kong Academy of Medicine (HKAM) AI Portal, which offers insights into ethical and legal aspects of AI in healthcare. Emphasis should be placed on developing the technical fluency to interpret AI-generated drug information, adverse event reports, and medication guidance, ensuring that human critical judgment always validates AI outputs before clinical application. This is crucial for pharmacists in their direct patient care roles, where precision and accuracy are non-negotiable.

1. **Pilot Programs**: Pharmacists in Hong Kong should advocate for and participate in small-scale pilot programs within their practice settings (e.g., community pharmacies, hospital pharmacies, or clinical units). These pilots could explore LLM applications in areas directly impacting patient care, such as generating initial responses to common drug information queries, assisting with medication reconciliation, or flagging potential drug interactions for pharmacist review. Given the current absence of specific AI guidelines for pharmaceutical products from the Hong Kong Department of Health or the Pharmacy and Poisons Board, these pilots must strictly adhere to a 'human-in-the-loop' design, where AI outputs are always reviewed and validated by a qualified pharmacist to ensure patient safety and compliance with existing regulations.

2. **Collaboration**: Hong Kong pharmacists should actively seek collaborations with local AI technology providers, academic institutions (such as the University of Hong Kong and Chinese University of Hong Kong), which are already engaged in medical AI discussions, and regulatory consultants. This collaboration is vital to ensure that AI tools are developed and implemented with a deep understanding of Hong Kong's specific healthcare context, patient needs, and the nuances of local pharmaceutical practice. Engaging with these partners can help tailor AI solutions that are not only technologically advanced but also ethically sound and culturally appropriate for the Hong Kong population.

3. **Regulatory Engagement**: Given the current absence of dedicated AI-specific legislation for pharmaceutical products in Hong Kong, pharmacists must maintain an active and proactive dialogue with key local health authorities. This includes the Pharmacy and Poisons Board (PPB), which oversees traditional drug registration. Pharmacists, with their direct involvement in medication use and patient safety, are uniquely positioned to provide invaluable practical insights and feedback to help shape future, specific guidelines for AI and LLM use in the pharmaceutical industry, ensuring they are robust, practical, and patient-centric. Adherence to general ethical AI frameworks and data privacy guidelines from the Digital Policy Office and Office of the Privacy Commissioner for Personal Data (PCPD) remains crucial during this evolving period.

CONCLUSION

The integration of LLM agents in the pharmaceutical industry represents a transformative opportunity. By understanding the underlying transformer architecture and self-attention mechanisms, pharmacists can better appreciate how these sophisticated AI systems can enhance regulatory efficiency, accuracy, and compliance.

As the pharmaceutical landscape continues to evolve, those who embrace and effectively implement these AI technologies will gain significant competitive advantages in drug development, regulatory approval, and market access. The key to success lies in thoughtful implementation that combines the power of AI automation with the irreplaceable value of human expertise and oversight.

For Hong Kong pharmacists, now is the time to begin exploring these technologies, understanding their capabilities and limitations, and preparing for a future where AI agents serve as invaluable partners in ensuring safe, effective medicines reach patients as efficiently as possible.

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