



UNIVERSIDADE D
COIMBRA

Matilde Alves Pitadas Santos

Relatórios de Estágio e Monografia intitulada “The Pharmacist Role in High-Performance Sports: An Emerging Area”, sob a orientação da Dra. Dina Lopes, do Dr. João Pimentel e do Professor Doutor Luís Miguel Santos Loura, apresentados à Faculdade de Farmácia da Universidade de Coimbra, para apreciação na prestação de provas públicas de Mestrado Integrado em Ciências Farmacêuticas.

Setembro de 2023



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Setembro de 2023

Eu, Matilde Alves Pitadas Santos, estudante do Mestrado Integrado em Ciências Farmacêuticas, com o n.º 2018307178, declaro assumir toda a responsabilidade pelo conteúdo do Documento Relatórios de Estágio e Monografia intitulada “The Pharmacist Role in High-Performance Sports: An Emerging Area” apresentado à Faculdade de Farmácia da Universidade de Coimbra, no âmbito da unidade de Estágio Curricular.

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Coimbra, 8 de setembro de 2023.

A handwritten signature in black ink, reading "Matilde Alves Pitadas Santos", is written over a horizontal line. The signature is cursive and fluid.

(Matilde Alves Pitadas Santos)

Levo histórias e segredos teus, fica a saudade no adeus.

(Coimbra, Queima das Fitas 2022)

Agradecimentos

Aos meus pais, pelo apoio incondicional e por todo o esforço para me proporcionarem sempre o melhor. Por nunca me deixarem desistir e me motivarem a ser a minha melhor versão. Um eterno obrigada nunca será suficiente.

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A ti Coimbra, que foste casa. Deixo-te com um sentimento de concretização e de saudade.

Ho fim do capítulo mais bonito.

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Parte I

Relatório de Estágio no INFARMED, I.P.



Sob orientação da Dra. Dina Lopes em colaboração com toda a equipa da Direção de Avaliação de Medicamentos / Unidade de Manutenção no Mercado (DAM/UMM)

Lista de Abreviaturas

AIM: Autorização de Introdução no Mercado

CAM: Comissão de Avaliação de Medicamentos

DAM: Direção de Avaliação de Medicamentos

EME: Estado Membro Envolvido

EMR: Estado Membro de Referência

FFUC: Faculdade de Farmácia da Universidade de Coimbra

FI: Folheto Informativo

INFARMED, I.P.: Autoridade Nacional do Medicamento e Produtos de Saúde, I.P.

MiCF: Mestrado Integrado em Ciências Farmacêuticas

RCM: Resumo das Características do Medicamento

ROT: Rótulo

SWOT: Strengths, Weaknesses, Opportunities and Threats

TAIM: Titulares de AIM

UAC: Unidade de Avaliação Científica

UEC: Unidade de Ensaio Clínicos

UIM: Unidade de Introdução no Mercado

UMM: Unidade de Manutenção no Mercado

I. Nota Introdutória

O estágio curricular representa o fim do percurso académico, o fim dos últimos cinco anos de aprendizagem no Mestrado Integrado em Ciências Farmacêuticas (MiCF).

A Faculdade de Farmácia da Universidade de Coimbra (FFUC), possibilita, para além do estágio curricular em Farmácia Comunitária, a realização de um estágio em Indústria Farmacêutica, Entidades Regulamentares ou Farmácia Hospitalar. Deste modo, permite a aquisição de novas competências e conhecimento no contexto profissional em que somos inseridos. Proporciona-nos uma aproximação à realidade que se avizinha e uma preparação, da melhor maneira possível, para que sejamos profissionais de saúde multidisciplinares, responsáveis, conscientes e competentes.

A oportunidade de estagiar no INFARMED, I.P. - Autoridade Nacional do Medicamento e Produtos de Saúde, I.P., permitiu-me conhecer a perspetiva da Entidade Reguladora, conhecimento este, que não me seria possível adquirir em mais nenhum local.

Este estágio foi realizado na Direção de Avaliação do Medicamento (DAM), na Unidade de Manutenção no Mercado (UMM), no período de 9 de janeiro de 2023 a 31 de março de 2023.

2. Enquadramento – INFARMED, I.P.

O Infarmed, é uma pessoa coletiva de direito público integrada na administração indireta do Estado, dotada de autonomia administrativa e financeira e património próprio, que exerce a sua atividade sob a tutela do Ministro da Saúde e que constitui a Autoridade Nacional do Medicamento e Produtos de Saúde.¹

Foi fundado em 1993 e à data da sua criação, o Infarmed, era das poucas autoridades europeias que integrava todas as valências relativas ao medicamento.²

Tem como função e missão, regular e supervisionar os setores dos medicamentos de uso humano e produtos de saúde, entre os quais dispositivos médicos e produtos cosméticos e de higiene corporal. Desta forma, tem como objetivo garantir o acesso dos profissionais de saúde e dos cidadãos a medicamentos e produtos de saúde com os mais elevados padrões de proteção da saúde pública, garantindo que sejam seguros, eficazes e de qualidade.³

Esta autoridade nacional, é constituída por cinco órgãos: Conselho Diretivo, Fiscal Único, Conselho Consultivo, Comissões Técnicas Especializadas e Conselho Nacional da Publicidade de Medicamentos e Produtos de Saúde; e treze unidades orgânicas das quais oito se cingem a funções de negócios e as restantes a funções de suporte.¹

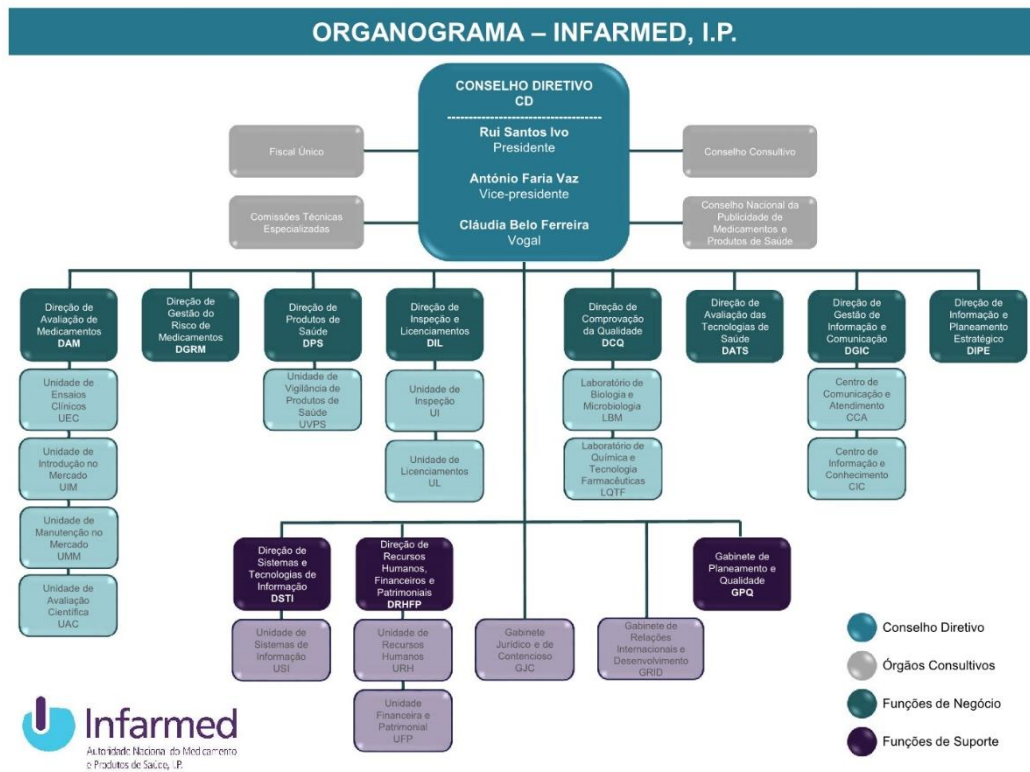


Figura 1 – Organograma INFARMED, I.P.¹

2.1. DAM

A DAM é responsável não só por atividades de avaliação, registo e autorização de medicamentos, mas também pela sua manutenção no mercado e a autorização da realização de ensaios clínicos com medicamentos.⁴

Sendo esta Direção constituída por quatro subunidades orgânicas, especializadas por área de intervenção, nomeadamente a Unidade de Ensaios Clínicos (UEC), a Unidade de Introdução no Mercado (UIM), a Unidade de Manutenção no Mercado (UMM) e a Unidade de Avaliação Científica (UAC).¹

2.1.1. UMM

A UMM encontra-se dividida em equipas responsáveis por diferentes tipos de procedimentos. Podem ser processos que decorrem apenas em território português, denominados Procedimentos Nacionais, ou Portugal pode ser um Estado Membro Envolvido (EME) ou Estado Membro de Referência (EMR) em processos europeus, podendo ser procedimentos por Reconhecimento Mútuo ou Descentralizado.

Foi nesta Unidade que o meu estágio curricular se enquadrou, mais especificamente nas Alterações em que Portugal atua como EMR.

3. Análise SWOT

Uma análise SWOT (*Strengths, Weaknesses, Opportunities, Threats*) fundamentada consiste, como o nome refere, numa análise dos pontos fortes e fracos, as oportunidades e as ameaças, observados ao longo do estágio, na integração da aprendizagem teórica, nomeadamente a nível da Unidade Curricular de Assuntos Regulamentares do Medicamento, em contexto profissional.

Tabela I. Análise SWOT

SWOT	
<p style="text-align: center;"><i>Strenghts</i></p> <ul style="list-style-type: none"> - Confiança nas capacidades e autonomia dos estagiários - Assuntos Regulamentares do Medicamento na perspetiva da Autoridade Regulamentar - Competências adquiridas 	<p style="text-align: center;"><i>Weaknesses</i></p> <ul style="list-style-type: none"> - Estruturação do Plano de Estágio - Ausência de interação com outras unidades ou sub-unidades da DAM
<p style="text-align: center;"><i>Opportunities</i></p> <ul style="list-style-type: none"> - Termos técnicos em inglês - Observação de um Plenário da Comissão de Avaliação de Medicamentos (CAM) - Contacto com profissionais experientes da Área Regulamentar 	<p style="text-align: center;"><i>Threats</i></p> <ul style="list-style-type: none"> - Falta de Recursos Humanos - Erros cometidos por parte dos Titulares de AIM (TAIM)

3.1. Pontos Fortes (*Strengths*)

3.1.1. Confiança nas Capacidades e Autonomia dos Estagiários

As primeiras semanas do estágio, basearam-se numa formação inicial e familiarização com as ferramentas de trabalho, cruciais para a realização e desenvolvimento das funções pretendidas. Após este período de tempo foi-me atribuída uma lista de processos, pelos quais fiquei responsável e me foi dada completa autonomia na execução dos mesmos.

Esta abordagem, desenvolveu um sentimento de responsabilidade em mim, devido ao grande impacto do trabalho que realizei a nível das Indústrias Farmacêuticas que submetem as suas alterações. Esta valorização permitiu, não só que me sentisse útil e valorizada, mas também que realizasse um trabalho que é de facto positivo e benéfico para o Infarmed.

3.1.2. Assuntos Regulamentares do Medicamento na perspetiva da Autoridade Regulamentar

Neste estágio, pude consolidar conhecimentos adquiridos a nível teórico da cadeira de Assuntos Regulamentares do Medicamento com a atividade prática. Através do contacto com diversos processos provenientes dos mais variados requerentes, em que Portugal atua com EMR, tive a oportunidade de observar e analisar detalhadamente os documentos submetidos, as questões levantadas pela autoridade regulamentar e as respectivas respostas, os comentários realizados pelos outros EME e proceder com a finalização das alterações.

3.1.3. Competências Adquiridas

Este estágio, possibilitou, o desenvolvimento de competências informáticas, tendo as tarefas que realizei sido desenvolvidas através de plataformas informáticas, a aquisição de novos termos em inglês devido ao uso deste idioma todos os dias e a expansão dos meus conhecimentos relativos à área de Assuntos Regulamentares do Medicamento.

O trabalho em processos diferentes simultaneamente, contribuiu para o desenvolvimento de uma maior capacidade organizacional.

3.2. Pontos Fracos (*Weaknesses*)

3.2.1. Estruturação do Plano de Estágio

O estágio iniciou-se com um período de formação global do trabalho da DAM, através da visualização de formações online e formações presenciais. Os restantes três meses foram estritamente alocados à realização da mesma tarefa. Considero, desta forma, que o estágio poderia ter sido mais estruturado, permitindo a aquisição dos conhecimentos essenciais para o desempenho correto das tarefas propostas. Sendo a DAM uma Direção tão abrangente, poderia estar incluído no Plano de Estágio a rotatividade pelas diversas unidades de trabalho, permitindo a aquisição de um espectro mais alargado de conhecimento.

3.2.2. Ausência de interação com outras unidades ou sub-unidades da DAM

A impossibilidade de contactar com outras unidades ou sub-unidades da DAM, revelou-se um ponto fraco do meu estágio. Não permitindo uma visão global de todas as funções desempenhadas por esta Direção.

3.3. Oportunidades (*Opportunities*)

3.3.1. Termos técnicos em inglês

O domínio inglês é crucial na Indústria Farmacêutica, sendo esta uma aptidão extremamente valorizada no ramo. Considero o meu conhecimento em inglês amplo, facilitando a realização do trabalho. No entanto, o confronto frequente com e-mails e documentos redigidos em inglês, permitiu-me enriquecer o meu vocabulário com novos conceitos e termos, que poderão vir a ser fundamentais, e até mesmo distinguir-me no mercado de trabalho.

3.3.2. Observação de um Plenário da Comissão de Avaliação de Medicamentos (CAM)

À Comissão de Avaliação de Medicamentos compete genericamente, sempre que solicitada, emitir pareceres em matérias relacionadas com medicamentos, designadamente no domínio da avaliação da qualidade, eficácia e segurança, bem como sobre quaisquer outros assuntos de carácter técnico-científico, que lhe sejam submetidos pelo Conselho Diretivo do Infarmed.⁵

Foi dada a oportunidade, aos estagiários da DAM, de assistir a um Plenário da CAM. Tendo sido importante para dar a conhecer como são solucionadas as questões levantadas durante a avaliação do medicamento de um pedido ou alteração de uma Autorização de Introdução no Mercado (AIM), qual o papel do técnico avaliador e da comissão em emitir pareceres referentes às questões submetidas. Permitiu o meu enriquecimento curricular e pessoal através da discussão por parte de especialistas para encontrar a solução para os problemas apresentados.

3.3.3. Contacto com profissionais experientes da Área Regulamentar

O estágio no Infarmed, permitiu-me adquirir novos conhecimentos através do contacto com profissionais da área regulamentar extremamente competentes. Transmitindo a sua vasta

experiência e fazendo-me progredir rapidamente enquanto gestora das alterações em que Portugal atua como EMR.

Ao longo do estágio, adquiri uma noção mais profunda sobre a legislação nesta área e permitiu-me obter uma visão abrangente de como funciona a autoridade regulamentar no geral e em determinadas situações mais específicas e quais os seus métodos de trabalho.

3.4. Ameaças (*Threats*)

3.4.1. Falta de Recursos Humanos

No início do estágio curricular, as minhas orientadoras definiram uma lista com alguns processos para eu avaliar. Tanto as minhas orientadoras, como toda a equipa da UMM, demonstraram sempre disponibilidade para esclarecer qualquer questão. No entanto, notava-se da sua parte uma sobrecarga de trabalho, o que por vezes, as minhas dúvidas podiam provocar um atraso no seu trabalho ou poderiam não estar disponíveis no momento. Apesar da visível falta de recursos humanos, nenhuma das minhas questões ficou por responder.

A falta de recursos humanos, nota-se não só na sobrecarga de trabalho dos membros da equipa mas também nas lista de processos destinada aos estagiários, sendo que a maioria das alterações eram de 2021 e 2022 e que necessitavam de ser avaliadas de modo a que se conseguisse proceder com as novas alterações submetidas mais recentemente.

3.4.2. Erros cometidos por parte dos TAIM

Os TAIM para procederem a alterações no Resumo das Características do Medicamento (RCM), Folheto Informativo (FI) ou no Rótulo (ROT), submetem alterações, cujo tipo varia consoante as alterações propostas, que são posteriormente avaliadas pelos gestores do processo. Dependendo do tipo de alteração, têm que submeter certos documentos de acordo com as guidelines.

Em diversas situações, durante a análise do processo havia documentação em falta, desatualizada ou incorretamente preenchida, adiando a validação do processo. Nestes casos, realizámos um pedido de elementos à indústria, ao qual tinham trinta dias úteis para responder. Aliado ao reduzido período de estágio, estes erros, prolongavam a análise de um processo, impedindo a análise de novos.

4. Considerações Finais

A oportunidade de realizar um estágio curricular na Autoridade Regulamentar do Medicamento foi extremamente enriquecedora, tanto no âmbito profissional como pessoal. Tendo os conhecimentos adquiridos na cadeira de Assuntos Regulamentares do Medicamento, de cariz obrigatório, sido fundamentais para realizar o estágio curricular no Infamed, I.P.. Foi uma experiência única, que me deu a perspetiva do lado da entidade regulamentar, proporcionando-me uma visão abrangente e única nesta área.

O farmacêutico tem um papel de extrema relevância e responsabilidade nas mais diversas áreas, sendo que estas estão em constante evolução, cabe ao farmacêutico acompanhar este crescimento enquanto profissional consciente e responsável na área da saúde. Esta é uma noção que todos adquirimos ao longo do tempo sem ser necessário qualquer estágio ou experiência profissional, no entanto, foi neste estágio que senti esse “peso” de responsabilidade. Terminando com grandes perspetivas futuras e com o sentimento de uma formação mais completa na área de assuntos regulamentares.

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Parte II

Relatório de Estágio em Farmácia Comunitária

Farmácia Adriana



Sob orientação do Dr. João Pimentel em colaboração com
toda a equipa da Farmácia Adriana

Lista de Abreviaturas

FA: Farmácia Adriana

FFUC: Faculdade de Farmácia da Universidade de Coimbra

MiCF: Mestrado Integrado em Ciências Farmacêuticas

MNSRM: Medicamentos Não Sujeitos a Receita Médica

SNS: Sistema Nacional de Saúde

SWOT: *Strengths, Weaknesses, Opportunities, Threats*

I. Nota Introdutória

O farmacêutico, enquanto especialista do medicamento, tem um papel preponderante na promoção da saúde e do bem-estar da população. Na farmácia comunitária desempenha um papel com uma grande proximidade do cidadão, sendo a farmácia o primeiro local ao qual os portugueses se deslocam em questões de saúde.¹

A Farmácia Comunitária, tornou-se numa estrutura fundamental e complementar à atividade do Sistema Nacional de Saúde (SNS), garantindo a acessibilidade ao medicamento e à prestação dos mais diversos serviços. O farmacêutico, apresenta uma elevada competência em farmacoterapia, sendo determinante o seu papel da promoção do uso responsável do medicamento. No entanto, destacam-se alguns serviços nos quais o farmacêutico tem uma posição privilegiada para contribuir ativamente como a gestão da terapêutica, a revisão da medicação, a prevenção da doença e a promoção de estilos de vida saudáveis.¹

O Estágio Curricular em Farmácia Comunitária, encontra-se inserido no plano de estudos do Mestrado Integrado em Ciências Farmacêuticas (MiCF) da Faculdade de Farmácia da Universidade de Coimbra (FFUC), dá a oportunidade aos estudantes de consolidar e aprofundar o conhecimento adquirido ao longo dos cinco anos desta formação académica, aproximando a vertente teórica à realidade profissional através de um ambiente propício à consolidação das competências técnicas, científicas e humanas. Considerando que este estágio é fulcral para a formação profissional de um futuro farmacêutico.

No âmbito desta Unidade Curricular, optei por realizar o meu estágio na Farmácia Adriana, em Coimbra, durante o período de 3 de abril de 2023 a 31 de julho de 2023, sob a orientação do Dr. João Pimentel e da restante equipa.

Este relatório, consiste numa análise SWOT (*Strengths, Weaknesses, Opportunities, Threats*) fundamentada, abordando assim de forma crítica, os pontos fortes e fracos, oportunidades e ameaças. Serão ainda relatados cinco casos práticos reais com que me deparei durante o estágio.

2. Análise SWOT

Uma Análise SWOT (*Strengths, Weaknesses, Opportunities, Threats*) consiste numa análise dos pontos fortes, pontos fracos, oportunidades e ameaças.

Tabela I. Análise SWOT

ANÁLISE SWOT	
<i>Strengths</i> <ul style="list-style-type: none">- Integração na equipa- Autonomia- Protocolos com instituições	<i>Weaknesses</i> <ul style="list-style-type: none">- Erros de stock- Proximidade a outra farmácia
<i>Opportunities</i> <ul style="list-style-type: none">- Diversidade de utentes- Público estrangeiro	<i>Threats</i> <ul style="list-style-type: none">- Medicamentos Esgotados- Estabelecimentos de venda de MNSRM

2.1. Pontos Fortes (*Strengths*)

2.1.1. Integração na equipa

A equipa desempenha um papel fundamental no sucesso de qualquer profissional. Como estagiária, rapidamente me senti integrada num grupo de trabalho organizado, coeso, sempre acompanhado de um espírito positivo, boa disposição e uma vontade contagiante de trabalhar. A Farmácia Adriana (FA) ao integrar vários estagiários ao longo do ano, acaba por ter uma maior facilidade na compreensão das dificuldades sentidas por estes.

2.1.2. Autonomia

Desde o início do meu estágio, que a equipa da FA me encorajou a realizar todas as tarefas de forma independente. Demonstrando sempre a confiança que depositam nos estagiários durante todo o estágio, contribuindo para o rápido desenvolvimento das capacidades de execução de tarefas. Como resultado, tornei-me independente mais rapidamente na realização das atividades diárias da farmácia, o que também contribuiu para a eficiência geral do seu funcionamento. Independentemente disso, a equipa estava sempre disponível para esclarecer qualquer dúvida, demonstrando confiança no meu trabalho e tornando-me mais responsável e consciente na execução de cada tarefa.

2.1.3. Protocolos com instituições

A FA atualmente possui acordos com algumas instituições em Coimbra que têm sido bastante vantajosas para a atração de novos clientes. A farmácia encarrega-se de se deslocar a estas instituições, para o fornecimento de medicamentos necessários, e, em alguns casos, prepara a medicação semanal para os utentes. Durante o meu estágio, tive a oportunidade de fornecer essa medicação, verificar as receitas e preparar a documentação para posterior faturação.

2.2. Pontos Fracos (*Weaknesses*)

2.2.1. Erros de *stock*

Na FA, todos os produtos que podem ser dispensados devem estar registados em *stock*, o qual pode ser consultado através do Sifarma[®]. No entanto, muitas vezes, o *stock* que existia na farmácia não coincidia com as informações registadas no Sifarma[®], causando alguns problemas, principalmente durante o atendimento. Uma vez que não haveria em *stock* um determinado medicamento, teria de ser feita uma encomenda, na qual poderia resultar na necessidade de retorno do utente à farmácia ou na perda da venda caso este não se pudesse deslocar novamente à farmácia.

2.2.2. Proximidade a outra farmácia

A existência de outra farmácia a menos de 100 metros da FA, traduz-se numa diminuição do possível fluxo de utentes, conseqüentemente, num menor número de atendimentos diários. Não sendo só este o problema derivado da elevada proximidade entre farmácias, sendo que recorrentemente, durante o meu período de estágio, diversos utentes que se deslocavam à farmácia para a compra de algum medicamento ou produto, questionavam o preço, caso não concordassem com o valor, utilizavam a típica frase “então vou ver à farmácia do lado”. Se não houvesse esta proximidade, não haveria tantas situações similares.

2.3. Oportunidades (*Opportunities*)

2.3.1. Diversidade de Utentes

Uma vez que a FA, se encontra próxima do Pólo I da Universidade de Coimbra, um dos públicos-alvo é o público universitário, que muitas vezes procura na farmácia suplementos alimentares para melhorar o desempenho cognitivo, reduzir o cansaço e acalmar o stress durante a época de exames. Além disso, lidamos frequentemente com pedidos relacionados a

contracetivos, como a pílula do dia seguinte e testes de gravidez. Permitindo melhorar o meu aconselhamento neste tipo de situações.

Por outro lado, a farmácia também atende regularmente utentes mais idosos que residem nas proximidades e que tomam outro tipo de medicação, especialmente medicação crónica para doenças como hipertensão e diabetes. Portanto, devemos prestar especial atenção a estes pacientes, sem nunca negligenciar os outros, uma vez que a toma de vários medicamentos para a população mais idosa, pode tornar-se por vezes confusa ou até mesmo haver uma sobreposição de medicamentos que podem levar a ocorrência de efeitos indesejáveis, duplicações e contraindicações.

2.3.2. Público estrangeiro

Devido à localização da FA na Praça da República, um local que habitualmente é muito frequentado por turistas, a presença destes era recorrente, ocasionalmente procurando ajuda para tentar resolver pequenas situações ou por vezes situações mais complicadas. Maioritariamente, estes utentes chegavam à farmácia com um produto específico em mente, porém estes produtos não existiam em Portugal grande parte das vezes. Sendo, no entanto, geralmente possível contornar a situação ao questionar o utente sobre qual era a finalidade do produto, e assim encontrar uma alternativa igualmente eficaz. Outro aspecto positivo deste estágio foi a oportunidade de aprimorar a comunicação e termos técnicos em inglês.

2.4. Ameaças (*Threats*)

2.4.1. Medicamentos Esgotados

Os medicamentos esgotados, foram uma realidade com a qual me deparei diariamente. É importante destacar que a farmácia não tem culpa nesta situação, mas, por vezes, os utentes não compreendem isso. Em diversas situações, tornava-se ainda mais complicado quando o médico prescrevia um medicamento pelo nome comercial e, como este se encontrava esgotado não podíamos fornecer uma alternativa, como por exemplo um medicamento genérico, que poderia estar disponível na farmácia. Isso comprometia o tratamento, pois exigia que o utente entrasse novamente em contacto com o médico para obter uma nova receita, atrasando assim o início do tratamento.

2.5. Estabelecimentos de venda de MNSRM

A venda de medicamentos não sujeitos a receita médica (MNSRM) fora das farmácias representa várias ameaças. A falta de qualificação e conhecimento dos profissionais que dispensam estes medicamentos representa um risco para a saúde pública, facilitando o uso incorreto do mesmos e, conseqüentemente, colocando em risco a saúde dos utentes. Isto poderia ser evitado com a supervisão e aconselhamento fundamentado e seguro por parte de um farmacêutico.

Além disso, devido ao tamanho e ao poder de compra destes estabelecimentos comerciais, os preços praticados por estes representam uma ameaça para a receita das farmácias, uma vez que são consideravelmente mais baixos.

3. Considerações Finais

A realização do estágio em farmácia comunitária marcou a etapa final do meu percurso académico, permitindo-me aplicar os conhecimentos que adquiri num contexto profissional. Uma parte que considero fundamental foi, para além da consolidação dos conhecimentos técnico-científicos adquiridos, a integração num contexto real profissional do dia-a-dia de um farmacêutico comunitário.

Vivenciei a realidade da importância que o farmacêutico tem não só num contexto de prestação de cuidados de saúde com qualidade, sendo frequentemente a primeira linha de contacto em situações de urgência, como quando é procurado para o esclarecimento de dúvidas relacionadas com a sua medicação ou condições patológicas. Para além do papel de farmacêutico, profissional responsável pelo medicamento e promotor de saúde e bem-estar, é também um “amigo” para pessoas que muitas vezes recorrem à sua farmácia de eleição apenas para conversar. Esta proximidade acaba por criar uma ligação e estabelecer um elevado nível de confiança entre o farmacêutico e os utentes.

Neste estágio aprendi os valores e o significado de ser um profissional de saúde de excelência através de todos os profissionais que trabalharam comigo ao longo destes quatro meses. Terminei o estágio com um sentimento de autoconfiança e autonomia no aconselhamento e atendimento ao público, preparada para a entrada no mercado de trabalho.

4. Aconselhamento

4.1. Caso I: Stress e Ansiedade

A.H., utente do sexo masculino, com cerca de 22 anos, deslocou-se à farmácia com queixas de dificuldade em dormir e em se concentrar durante o dia. Referiu que tinha um exame muito importante na semana seguinte e que se encontrava sob grande pressão e stress.

No início questionei se tomava alguma medicação para a ansiedade e se estes episódios eram recorrentes, ao qual o utente me respondeu que não tomava nenhuma medicação e que nunca tinha acontecido nenhum episódio similar.

De seguida, revi com o utente medidas não farmacológicas que poderiam ajudar a resolver a situação. Realçando a importância de horários de sono regulares, refeições equilibradas, evitar estimulantes como o café durante a tarde e principalmente depois de jantar e salientei a importância da prática regular de exercício físico, como por exemplo, uma caminhada. O utente, afirmou que já seguia todas estas recomendações, exceto a prática regular de exercício físico e comprometeu-se a dedicar parte do seu tempo a esta recomendação no futuro.

Após a conversa com o utente, este fez questão de levar algo que o pudesse auxiliar neste período de elevado stress. Aconselhei-o então Stressfytol[®], um indutor de relaxamento, composto por *Passiflora incarnata*, considerada uma planta medicinal que ajuda a combater a ansiedade, insónia e acalma o nervosismo. Stressfytol[®] não causa sonolência, habituação ou dependência e apresenta uma ação ansiolítica rápida e eficaz.² Por fim, expliquei ao utente como realizar a sua toma, 1 a 2 comprimidos de manhã e 1 a 2 comprimidos à noite para ajudar na redução da ansiedade e stress, e 1 a 2 comprimidos, 2 horas antes de se deitar para situações de ansiedade noturna.

4.2. Caso II: Desparasitante para animal de estimação

P.B., utente do sexo masculino, deslocou-se à farmácia afirmando que encontrou uma carraça no seu cão, procurando um desparasitante externo.

Comecei por questionar o utente relativamente ao peso e idade do animal. Ao qual me respondeu que o cão tinha cerca de 30 kg e já tinha 4 anos.

Após a obtenção desta informação, aconselhei Amflee® Combo, indicado para o tratamento e prevenção de pulgas e carraças. É composto por Fipronil, um inseticida, e (S)-Metopreno, que interfere com o ciclo de vida do inseto, impedindo-o de se reproduzir.

De seguida, informei o utente de algumas precauções a ter, como evitar dar banho ao animal nos 2 dias após a aplicação, aplicar o medicamento numa zona em que o animal não consiga lamber e não aplicar em zonas da pele do animal que apresentem lesões. Por fim, expliquei como aplicar o produto, segurando a pipeta na vertical, afastar o pelo entre as omoplatas até a pele ser visível e esvaziar completamente o conteúdo da pipeta.

4.3. Caso III: Infecção urinária

T.B., utente do sexo feminino, com cerca de 30 anos, dirige-se à farmácia e pede Monuril[®], dizendo estar com uma infecção urinária e que da última vez este foi o medicamento prescrito pelo médico.

Comecei por explicar à utente que o Monuril[®] (fosfomicina) é um medicamento sujeito a receita médica, por isso não me seria possível dispensar sem prescrição médica. De seguida, questionei-a relativamente aos sintomas que apresentava e quando tiveram início, ao qual me respondeu que no dia anterior tinha começado com dor e ardor ao urinar e aumento da frequência urinária. Expliquei à utente que à partida a infecção não se encontrava num estado muito avançado e que poderia aconselhar-lhe um suplemento à base de plantas destinado ao alívio dos sintomas de infeções urinárias ligeiras, o Cysticlean[®].

O Cysticlean[®] é composto por extrato de arando vermelho que apresenta propriedades antibacterianas, evitando a aderência das bactérias ao epitélio da uretra.

De seguida, expliquei como proceder com a toma, aconselhando a toma de uma cápsula de manhã e outra à noite com um copo de água, durante 15 dias. Além da toma do suplemento, aconselhei a utente a ingerir bastante água diariamente e à complementação da toma do suplemento com vitamina C, que acidifica a urina, inibindo o proliferamento bacteriano.

Aconselhei a utente a evitar a utilização de roupa muito justa e a utilizar um produto de higiene íntima adequado, como o Lactacyd[®] de modo a proteger a flora intestinal.

Por fim, referi que caso a situação não melhorasse ou houvesse um agravamento da mesma, deveria consultar um médico.

4.4. Caso IV: Cross-Selling

M.B., utente do sexo feminino, com cerca de 40 anos, deslocou-se à farmácia com uma receita de um antibiótico (Amoxicilina + Ácido Clavulânico 875 mg + 125 mg).

A utente referiu no início que nunca tinha tomado este medicamento, questionando como deveria proceder à toma do mesmo. Indiquei então que a toma deveria ser realizada de 12 em 12 horas até ao fim da embalagem.

De seguida, considerei oportuno alertar a utente para os distúrbios gastrointestinais como efeito indesejável frequente dos antibióticos, aconselhando a toma de um probiótico para o equilíbrio da flora intestinal.

Desta forma aconselhei a toma de Atyflor[®], este é considerado um suplemento alimentar que contém uma mistura de diversas estirpes de probióticos que ajudam a restabelecer a microflora intestinal. Indiquei que deveria tomar uma saqueta por dia durante ou após as refeições, dissolvendo o conteúdo da saqueta em água, sumo ou leite.

4.5. Caso V: Pele acneica

L.M., deslocou-se à farmácia com a sua filha C.A., de 16 anos, com queixas relativas à sua pele que se encontrava frequentemente oleosa e com acne, maioritariamente na face. C.A. é saudável, não toma qualquer tipo de medicação nem utiliza produtos cosméticos.

Após a observação da pele de C.A., optei por aconselhar um gel de limpeza, um creme hidratante matificante e um gel secante, específicos para pele com tendência acneica.

Aconselhei a gama de produtos para peles acneicas Stop Akn BABÉ®. O gel de limpeza apresenta uma ação queratolítica devido à presença de ácido salicílico na sua composição, apresenta também uma ação seborreguladora, desobstruindo os poros, reduzindo a inflamação e evitando o aparecimento de acne.³ O creme hidratante matificante, hidrata a pele com um acabamento sem brilho, controla as bactérias causadoras de acne e apresenta uma ação queratolítica, seborreguladora e cicatrizante.⁴ O gel secante, promove a cicatrização de lesões mantendo a hidratação da pele.⁵

Por fim, expliquei qual a rotina de aplicação dos produtos. O gel de limpeza deve ser utilizado diariamente, de manhã e à noite, aplicando no rosto húmido, massajando suavemente e enxaguar com bastante água. O creme hidratante é aplicado também de manhã e à noite, após a limpeza da pele. O gel secante, deve ser aplicado 2 a 3 vezes por dia na borbulha ou imperfeição a tratar.

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Parte III

Monografia

“The Pharmacist Role in High-Performance Sports: An Emerging Area”

Sob orientação do Professor Dr. Luís Miguel Santos Loura

Abbreviations List

ABP: Athletes Biological Passport

ADP: Adenosine Diphosphate

ASP: Athlete Support Personnel

ATP: Adenosine Triphosphate

cAMP: Cyclic Adenosine Monophosphate

COX: Cyclooxygenase

DCO: Doping Control Officer

EAAS: Endogenous Anabolic Androgenic Steroids

EPO: Erythropoietin

FAT: Final Accreditation Test

FIP: International Pharmaceutical Federation

GABA: Gamma-Aminobutyric Acid

GC-MS: Gas Chromatography Mass Spectrometry

GI: Gastrointestinal

Global DRO: Global Drug Reference Online

GPs: General Practitioners

IGF-I: Insulin-like Growth Factor-I

IOC: International Olympic Committee

JADA: Japan Anti-Doping Agency

JPA: Japan Pharmaceutical Association

NADO: National Anti-Doping Organization

NO: Nitric Oxide

NSAID: Nonsteroidal Anti-Inflammatory Drug

rhEPO: Recombinant Human Erythropoietin

TUE: Therapeutic Use Exemption

UNESCO: United Nations Educational, Scientific and Cultural Organization

USADA: United States Anti-Doping Agency

WADA: World Anti-Doping Agency

Abstract

Sports pharmacy is an emerging area that embraces several areas like doping control and prevention, injury prevention and management, and supplement and medication management, always focusing on the athlete's health.

Doping control is one of the roles a pharmacist can act in sports pharmacy, defined as the control of the use of prohibited substances or methods that enhance athletic performance. The World Anti-Doping Agency is responsible for anti-doping regulations, through the annual publication of The *Prohibited List* and The *Code*. The *Prohibited List* consists of a comprehensive document serving as the international standard for the identification of substances and methods prohibited in sports. While the *Code* has the purpose of universally harmonizing the core anti-doping elements in order to advance the anti-doping effort. Although many substances are prohibited, athletes can request a Therapeutic Use Exemption, when necessary, in the most diverse situations, such as chronic illness or conditions and necessary procedures.

Pharmacists are frequently approached not only for advice in sport injuries, being an important part of the pharmacological and non-pharmacological treatment besides their role in prevention and education, but they are also approached by athletes seeking advice about dietary supplements.

The approach to pharmacists by people who engage in sports and exercise frequently about a drug treatment, supplementation, injuries or in general healthcare that can affect their participation in sports, demonstrates a growing need for sports pharmacists who are specialized in sports and exercise.

Keywords: Dietary Supplements; Doping; Emerging Area; Sports Injuries; Sports Pharmacy

Resumo

A farmácia desportiva é uma área emergente que engloba diversas áreas, tais como controlo e prevenção de *doping*, prevenção e gestão de lesões, e gestão de suplementação e medicação, tendo sempre como foco a saúde do atleta.

O controlo de *doping* é uma das funções que o farmacêutico pode desempenhar na farmácia desportiva, sendo este definido como o controlo da utilização de substâncias ou métodos proibidos que melhoram o desempenho físico. A Agência Internacional Anti-*Doping* é responsável pela regulamentação anti-*doping*, através da publicação anual da Lista Proibida e do Código. A Lista Proibida consiste num documento abrangente que serve de padrão internacional para a identificação de substâncias e métodos proibidos no desporto. O Código tem como objetivo harmonizar universalmente os principais elementos anti-*doping*. Embora várias substâncias sejam proibidas, os atletas podem solicitar uma Isenção para Uso Terapêutico, quando necessário, nas mais diversas situações, como doenças crónicas e procedimentos necessários.

Os farmacêuticos são frequentemente procurados, não só para aconselhamento sobre lesões desportivas, sendo uma parte importante do tratamento farmacológico e não farmacológico, para além do seu papel na prevenção e educação, mas também por atletas que procuram aconselhamento sobre suplementos dietéticos.

A procura do farmacêutico por parte de atletas e pessoas que praticam exercício físico frequentemente sobre tratamentos farmacológicos, suplementos, lesões ou cuidados de saúde em geral que podem afetar a sua participação no desporto, demonstra uma necessidade crescente de farmacêuticos desportivos especializados em desporto e exercício.

Palavras-chave: Área Emergente; *Doping*; Farmácia Desportiva; Lesões Desportivas; Suplementos Dietéticos

I. Introduction

The pharmacist has multiple branches and areas to act upon and is equipped with a variety of skills, leading to a wide range of career opportunities and making him/her a highly qualified professional. Due to the natural evolution of the profession and pharmaceutical sciences, the healthcare ecosystem or the economic investment in certain areas, pharmacists have a considerable capacity to adapt to new challenges and needs of society.^{1; 2}

An “Emerging Area” is defined as a set of activities that fall under the pharmaceutical act or in acts not reserved to the pharmaceutical profession. As a result of professional, social, and economic evolution of health and pharmaceutical sciences, these areas have gained a greater relevance. Integrating a pharmacist based on qualifications and knowledge of medicines, medical devices, health products and the health ecosystem represents an added value in their execution.³ Sports pharmacy, as an emerging area, works with healthcare teams, athletes, coaches, anti-doping agencies, and others. The general roles performed by pharmacists in sports include educating, advising, dispensing, and monitoring drugs and supplements, as well as injury management and prevention. Nowadays, sports teams often have healthcare teams that oversee the care of athletes. However, among these teams, pharmacists have not been included as members.^{4; 5; 6} The lack of education of pharmacists or pharmacy students and exposure to sports supplementation or to the World Anti-Doping Agency (WADA) Prohibited List causes low confidence regarding these matters. However, a considerable group of pharmacists show enthusiasm in learning about sports pharmacy.^{7; 8; 9; 10}

WADA is responsible not only for developing and monitoring The World Anti-Doping Code, that harmonizes, throughout the world, the anti-doping rules and policies, but also for updating The Prohibited List every year.^{11; 12} Doping has become a complex issue in sports world, compromising the credibility and performance of the athletes. It also carries considerable medical risks, affecting the athlete’s health, their social relationships, reputation, and it can have a financial impact on their life.^{12; 13; 14} Besides many substances and methods being part of The Prohibited List, they can be necessary to treat illnesses, conditions or to undergo procedures. If the medication or method is required, a Therapeutic Use Exemption (TUE) can give the authorization to the athlete to use that substance or method while competing.¹⁵

Pharmacists have the knowledge and means to help address the public health issue that is doping in sports. Several studies show that despite the lack of educational bases and confidence, pharmacists appear to be enthusiastic about counselling athletes.⁹

2. Sports Pharmacy: An Emerging Area

In the most diverse sports, professional or even amateur, athletes have a team of healthcare professionals, who oversee injuries, supplementation, medication and, in general, every aspect of the athlete's health. However, pharmacists have not generally been included as a member of the care team.⁴

As the pharmacist's role continues to grow and develop in an extensive collection of areas in which the pharmacist can act, the role of the pharmacist in sports, competitive or non-competitive, is still practically non-existent.⁹ This role is described as an emerging specialty with focus on doping prevention and control, injury prevention and management, and first aid, having the responsibility of contributing to the health of athletes. Providing information about drugs and educating athletes, coaches and supporters is also considered an important part of the sports pharmacy. In all clinical settings, the pharmacist can complement the work of the sports healthcare team, often co-existing with most of the health specialties resulting in a more complete approach to patient care.^{9; 16; 17}

Some recommendations made by WADA to sports pharmacists are keeping up to date with the contents of the WADA Code, assisting athletes to recognize whether the use of a substance may be banned or restricted in their sport, as well as providing information to athletes about the risks and benefits of nutritional supplements. A large range of supplements contain banned substances, not mentioning them on the label, which causes some cases of accidental doping. The sports pharmacist must stay current with the changing recommendations from WADA or specific sports-governing organizations, concerning the use of appropriate products.⁹

3. Doping Practice

3.1. The Definition of Doping

The official doping definition was first described in 1963 by the European Committee Council: "Doping represents the use of substances or physiological mediators, which are not normally present in the human body, introduced as an external aid to increase the athletes' performance during a competition".¹³ The abuse of drugs, such as medications, dietary supplements, and other substances, by athletes has become a common problem. It is no longer surprising when an athlete tests positive for a banned substance, consequently being penalized with a doping violation.⁵

The Anti-doping Convention of the European Council defines “Doping in sports” as the administration or use of doping substances or methods by athletes. These doping substances and methods are the ones which have been banned by WADA, appearing on The Prohibited List, a list of ineligible substances. “Athletes” are defined as persons who participate in organized sports activities.¹³

WADA stipulates violations of anti-doping rules as the presence of a forbidden substance or its metabolites or markers in an athlete’s sample; the use or attempted use of one of these substances; the refusal, failure or dodging to submission of a sample collection; the violation of applicable requirements concerning athlete availability for out-of-competition testing; tampering or an attempt to with any doping control; possession of prohibited substances or methods; complicity to any doping violation, such as encouraging, covering up or conspiring; trafficking or an attempted trafficking of any prohibited substances or methods; and the administration or an attempt to administrate a prohibited substance or method to any athlete in or out-of-competition.^{12; 18}

The athletes who are subjected to doping regulations are confronted with complex rules and banned substances lists, creating several situations where there is a significant risk of accidentally consuming banned substances, either by self-medication or prescribed by a physician. These situations are called unintentional doping cases.⁵

3.2. Therapeutic Use Exemptions (TUE)

An athlete can be prescribed with prohibited substances due to an illness, a condition or a procedure. Type one diabetes, treated with the administration of insulin or the administration of exogenous testosterone in an athlete who has undergone bilateral orchiectomy for the treatment of testicular cancer, are two examples of cases where an athlete needs to use banned substances.¹²

The TUE is a form filled in by the physician and sent to the respective anti-doping agency, to register the athlete in order to be granted permission to take a prohibited substance. A multidisciplinary committee will review it and either approve or reject the TUE. To be approved, it has to follow four criteria: the athlete’s health will be compromised without the drug; the drug won’t enhance the athlete’s performance beyond what it would be if they didn’t have the medical condition; there are no reasonable alternatives; and the drug is not being used to treat a condition caused by another banned substance or method. The TUE Committee is chosen based on the type of competition whether it is at national or

international level. Since a TUE for the same substance can be reviewed by different TUE Committees, it can cause a conflict due to the fact that one TUE can be approved by a Committee, while another rejects it. In an attempt to respond to these types of conflicts, the policy of Mutual Recognition was adopted, where all sports federations, anti-doping organizations and Organizing Committees will recognize a TUE that has been granted by any TUE Committee that is a signatory to the World Anti-Doping Code.¹²

In emergency cases the athlete's health is always a priority, regardless of whether a treatment or medication is prohibited. The physician should afterward submit an emergency TUE to cover the emergency treatment.¹²

3.3. World Anti-Doping Agency (WADA)

The World Anti-Doping Agency (WADA) is an independent international agency founded in 1999 in Lausanne, Switzerland by sports federations and governments of the world. Its main role concerns the development, harmonization and coordination of the anti-doping rules and policies worldwide, emerging the World Anti-Doping Program Code and The Prohibited List.¹¹ This agency states that an athlete has the responsibility of any drug use, regardless of who provided or recommended it.¹⁰

WADA recognizes anti-doping laboratories based on strict criteria and performance measures.¹² For a Laboratory to be approved as candidate by WADA, it has to satisfy the following criteria:

- Expression of Interest: The applicant must contact WADA by writing expressing its interest.
- Submit Initial Application Form: a complete Application Form, provided by WADA, should be submitted, duly signed by the laboratory Director and, if relevant, by the Director of the host organization. The host country needs to satisfy several conditions, such as, the existence of a National Anti-Doping Program conducted by a National and/or Regional Anti-Doping Organization that complies with the Code and the International Standards of the World Anti-Doping Program, the ratification of the United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention against Doping in Sport, and the payment of the annual financial contributions to WADA.
- Provision of Letters of Support: a letter from host organizations accepted by WADA, guaranteeing sufficient annual financial support for a minimum of three years, the provision for adequate analytical facilities, human resources and

instrumentation, support for training programs, research and development activities; a letter of support from Signatories indicating a commitment to provide the Laboratory with a minimum of three thousand samples per year; and a declaration of impartiality and laboratory independence by the supporting Signatories;

- Provision of Business Plan: this plan shall include not only market considerations, facility, instrumental, human resources and training needs, but also a guarantee of long-term financial and staff provision.

Once the application is evaluated by WADA Executive Committee and the status of WADA Candidate Laboratory is granted, the process continues. This procedure starts with a complete and detailed questionnaire to the laboratory, then prior to entering the probationary period the initial accreditation fee must be paid, and the laboratory needs to implement and comply with the Code of Ethics and present the documentation demonstrating WADA that they will comply with the requirements of Laboratory Independence and Impartiality. Finally, they are subjected to a pre-probationary test and an on-site assessment. During this probationary period, the laboratory starts the work and if it is successfully completed and upon request by the laboratory stating its readiness to proceed further, a Final Accreditation Test (FAT) and on-site assessment is conducted by WADA. At the end of the entire accreditation process, a certificate is issued in recognition of the WADA accreditation.¹⁹

The sport organizations and governments that sign and follow the Code are considered signatories and share the responsibility to uphold and enforce the Code. This agency has several core missions that embrace cultivating a doping-free culture in sport, educating athletes about the harms of doping, and establishing international standards for anti-doping programs in order to maintain an equal and fair chance of each athlete to succeed.¹²

3.3.1. The Code

The World Anti-Doping Program embraces all elements necessary to guarantee the ideal harmonization and best practices in international and national anti-doping programs. This Program is based on *The Code*, an essential and universal document whose purpose is to harmonize universally the core anti-doping elements in order to advance the anti-doping effort.²⁰

This document has been, to date, signed by approximately 700 sports organizations, the Signatories.²⁰

The Signatories are required to accept, implement, and enforce The Code. By accepting, they're agreeing to the principles of The Code and agreeing to implement and comply with it. The implementation consists in amending the rules and policies to include all mandatory articles and principles of The Code. Enforcing is to incorporate the changes made while implementing it.²⁰

3.3.2. The Prohibited List

The *Prohibited List* consists of a comprehensive document serving as the international standard for the identification of substances and methods prohibited in sports. It is updated annually in order to reflect new substances and methods found to be used as doping. The substances and methods listed are considered performance-enhancing or potentially harmful to an athlete's health.^{21; 22}

The list is divided into several modules, such as substances and methods prohibited at all times, substances and methods prohibited in-competition, and substances prohibited in particular sports. It serves as a key component of The Code, being one of the most important parts of the global harmonization across the anti-doping movement.²¹ Sports medicine physicians must know these categories, to avoid doping violations.¹²

Every sports medicine provider responsible for taking care of athletes needs to be aware of which substances are banned and can result in a doping violation. There are three requirements, so a substance can be included in this list, however it only must meet two of them. The requirements are the following: it has to enhance or have the potential to, the sports performance; has to be a risk to the athletes' health; and violate the spirit of sport.¹²

The Prohibited List is divided into three modules, which have the following categories:

Table I. Table of Contents – Prohibited List by WADA²³

Module: <i>Substances and Methods prohibited at all times</i>
S0. Non-approved Substances
S1. Anabolic Agents
S2. Peptide Hormones, Growth Factors, related substances, and mimetics
S3. Beta-2 Agonists
S4. Hormone and Metabolic Modulators
S5. Diuretics and Masking Agents
M1.; M2.; M3. Prohibited Methods

Module: *Substances and Methods prohibited in-competition*

S6. Stimulants

S7. Narcotics

S8. Cannabinoids

S9. Glucocorticoids

Module: *Substances prohibited in particular sports*

PI. Beta-blockers

The substances mentioned in The *Prohibited List* are not approved to be taken recreationally, causing serious damage to the body of athletes or healthy people, when used.^{24;}

^{25; 26}

Anabolic Agents

The primary use of these substances is to treat delayed puberty, some types of impotence, and wasting of the body caused by muscle-wasting diseases.^{24; 25; 26} Anabolic Agents stimulate muscle growth and strength.²⁷

Some of the physiological effects of Anabolic Agents are acne, male pattern baldness, liver damage, premature closure of growth centers of long bones in adolescents, and stunted growth and disruption of puberty in children. The specific effects on the male gender are breast tissue development, impotence, shrinking of the testicles, and reduction in sperm production. On the female gender, the effects are deepening of the voice, enlarged clitoris, cessation of breast development, growth of hair on the face, stomach and upper back, and abnormal menstrual cycles.^{24; 25; 26}

Peptide Hormones, Growth Factors, and Related Substances

The three categories of substances in this class are erythropoietin (EPO) and agents affecting erythropoiesis, peptide hormones and their releasing factors, and growth factors and modulators. Their primary medical use includes cancer treatment or aiding newborns who were born prematurely.^{24; 25; 26} The human growth hormone has a performance-enhancing effect on the power of sprinters and due to its ability to stimulate cell division and cell growth it also builds muscle.²⁸ The use of EPO increases the number of red blood cells, which consequently transports higher doses of oxygen to the muscle, reducing the muscle fatigue and increasing exercise endurance.²⁹

The physiological effects caused by this class are hypertension, heart attacks, diabetes, tumors, thyroid problems, severe headaches, vision loss, acromegaly, high blood pressure, crippling arthritis, and heart failure.^{24; 25; 26}

Beta-2 Agonists

Beta-2 Agonists are primarily used to treat conditions such as asthma and other respiratory diseases.^{24; 26} Endurance athletes may benefit from these drugs, due to their improvement of oxygen uptake.³⁰

Palpitations, headaches, sweating, nausea, muscle cramps, and nervousness are the physiological effects presented by Beta-2 Agonists.^{24; 26}

Hormone and Metabolic Modulators

Hormone and Metabolic Modulators modify the effects of hormones to slow down or accelerate enzyme reactions, due to the synthetic compounds that act in the hormonal pathways.²⁶ These substances can manipulate hormone levels, which can potentially lead to muscle growth and improved performance.³¹

They can cause cardiac problems, dizziness, pain and weakness in joints, skin rashes, sweating, blurry vision, and difficulty breathing.²⁶

Diuretics

Diuretics are primarily used to treat conditions such as hypertension, kidney disease, and congestive heart failure.^{24; 26} These substances have the ability to mask the presence of other prohibited substances. In sports with weight classes, diuretics are used to reduce weight. They are also used in sports, such as body building to decrease the maximum water as possible in the body to make the muscles appear more defined.³²

The physiological effects presented by Diuretics are dehydration, muscle cramps, dizziness or fainting, drop in blood pressure, and loss of coordination and balance. When taken without medical supervision can result in potassium depletion and possibly even death.^{24; 26}

Stimulants

Stimulants primary use are to treat conditions such as asthma, narcolepsy, obesity and Attention Deficit Hyperactivity Disorder.^{24; 25; 26} They are used by athletes to increase alertness, concentration, metabolic rate, strength, power, and to reduce fatigue.³³

The physiological effects of Stimulants are insomnia, anxiety, weight loss, dependence and addiction, dehydration, tremors, increased heart rate and blood pressure, and increased risk of stroke, heart attack and cardiac arrhythmia.^{24; 25; 26}

Narcotics

Narcotics can relieve severe pain and induce sleep. However, a narcotic overdose can lead to respiratory depression and death.^{24; 26} The benefits it brings to athletes are the reduction of pain and inflammation, associated with training, competition or injuries, masking the pain and leading to an improved performance.³⁴

False sense of invincibility, nausea, vomiting, decreased heart rate, increased pain threshold and failure to recognize injury, and physical and psychological dependence and addiction are the physiological effects caused by Narcotics.^{24; 26}

Cannabinoids

Cannabinoids can interact with other drugs, having a sedative effect that can lead to severe complications. The physiological effects presented by these are increased heart rate, mood instability, impaired short-term memory, slowed coordination and reaction of reflexes, diminished ability to concentrate, impaired thinking and reading comprehension, distorted sense of time and space, and respiratory diseases.^{24; 26} Cannabinoids are banned in most sports due to their potential to impaired coordination and delayed reactivity.³⁵

Glucocorticoids

Glucocorticoids' primary use is to treat allergies, asthma, inflammatory conditions, and skin conditions.^{24; 26} These substances have pain-relieving and anti-inflammatory effects.³⁶

The physiological effects that Glucocorticoids can cause are loss of muscle mass, weakening of injured areas, bone, tendon or ligament, and decrease in or cessation of growth in young people.^{24; 26}

Beta-Blockers

Beta-Blockers are primarily used to control hypertension, cardiac arrhythmias, migraines, angina pectoris, and nervous or anxiety related conditions.^{24; 26} They reduce anxiety, lower the heart rate and have a strong relaxing effect, preventing the muscle trembling. It is most commonly used in sports that require accuracy and concentration.³⁷

The physiological effects of Beta-Blockers are the lowering of blood pressure, slow heart rate, sleep disorders, and spasm of the airways.^{24; 26}

4. Dietary Supplements

Dietary supplements play a crucial role in wellbeing and lifestyle.³⁸ They boost the nutritional intake, performance, and muscle mass of athletes. Accidental doping also occurs with the use of nutritional supplements, due to the misinformation presented in the supplement's labels, misleading the athletes and their teams.^{7; 9; 12} The increase of multiple supplements intake among athletes for their needs can also create the risk for potential safety concerns or drug interactions that health professionals may not notice right away. Therefore, sports supplements education is essential for athletes.^{8; 39}

The main purpose of dietary supplements in sports is the improvement of health and performance, to aid in training recovery, to prevent or treat an illness and injuries and to supplement an unbalanced diet.^{8; 40} The following four examples have robust evidence that they can enhance sports performance, when used according to protocols.

4.1. Caffeine

Caffeine is a common stimulant among athletes that is used for its ergogenic effects, this happens mainly through three primary mechanisms:

- Increase muscle calcium release: caffeine in high concentrations interferes with the uptake and storage of calcium in sarcoplasmic reticulum and increases the translocation of calcium through the plasma membrane.
- Caffeine and phosphodiesterase: caffeine increases an intracellular concentration of cyclic adenosine monophosphate (cAMP) through the inhibition of phosphodiesterase enzymes in skeletal muscle and adipose tissues, promoting lipolysis which leads to the release of free fatty acids and glycerol.

Due to the higher availability of fatty acids and glycerol in skeletal muscle, the muscle glycogen is spared.

- Antagonism at the level of adenosine receptors: the ability of caffeine to inhibit adenosine receptors results from the competitive binding of caffeine and paraxanthine to adenosine receptors. When adenosine inhibitory effects through its receptors are blocked, the release of norepinephrine, dopamine, acetylcholine, serotonin, glutamate, and gamma-aminobutyric acid (GABA) are indirectly affected. Adenosine is responsible for fatigue when it binds to its receptor, so by caffeine preventing this binding it delays fatigue.^{41; 42; 43; 44}

This substance must be taken before competition. However, athletes should abstain at least seven days before competition in order to allow adenosine receptors downregulation.⁴⁴

The possible undesirable effects that can occur are anxiety, insomnia, restlessness, nausea, arrhythmias, hypertension, tremor, headache, and diarrhea.⁴⁴

4.2. Creatine

Supplementation with creatine and chronic training combined lead to several benefits, such as the increase of muscle mass and improvements in muscular strength and power.⁴⁴

Creatine is a nitrogen compound that the body synthesizes in the pancreas and liver using amino acids glycine, arginine, and methionine. Approximately 95% is stored in skeletal muscle and within the muscle about two-thirds of the creatine exists in the form of phosphocreatine, while the remaining is stored as free creatine. The phosphocreatine stores are used, during intense workout, to generate a adenosine triphosphate (ATP), that is a source of energy. However, during this process, phosphocreatine stores become depleted and energy sources available start to diminish and so does the ability to maintain a high-intensity exercise. Creatine rephosphorylates adenosine diphosphate (ADP) to ATP helping to sustain the high-intensity physical activity, due to the increase of the body's phosphocreatine stores.^{43; 44; 45}

4.3. Beta-Alanine

Beta-Alanine serves as a supplement to reduce intramuscular acidosis that contributes to fatigue during a high-intensity exercise. It is a non-essential amino acid produced in the liver and is the rate-limit factor to the intramuscular synthesis of carnosine, which acts as an intracellular buffer within the muscle tissue. The supplementation with beta-alanine has the

aim to enhance the muscular buffering capacity of carnosine, since that when carnosine levels in muscle tissue rise, beta-alanine helps to buffer the buildup of hydrogen ions H^+ that happens as a result of physical activity. H^+ , responsible for lowering values of pH in the muscle, is produced when lactic acid disassociates to lactate which contributes to the sensation of fatigue.^{43; 44; 46}

The only known undesirable effect is paresthesia, that happens by acute plasma elevation of beta-alanine after a single dose. It can be resolved by dividing the total dose throughout the day.⁴⁴

4.4. Nitrate

Nitrate has several performance benefits during physical activity, it can reduce the oxygen cost, can improve exercise tolerance, and enhance repeated sprint performance. The mechanism behind these benefits is the conversion of nitrate into nitrite and nitric oxide (NO) in the body. NO plays a fundamental role in blood vessel dilatation, that improves blood flow and oxygen delivery to the muscles, leading to improved tolerance and exercise performance.^{43; 44; 47}

This substance is not carcinogenic, but if nitrite sources react with amino compounds, an endogenous nitrosation, when ingested it may increase the risk of cancer.⁴⁴

4.5. Ketones

Ketones are produced by the liver to be used as an energy source when there is a glucose absence. If the body's carbohydrate stores are depleted, the body starts to break down fat for energy producing the ketones that become the body and brain's main source of energy, this process is called ketosis.^{48; 49; 50} The reduction of carbohydrate availability is associated with fatigue and the ketone bodies have the potential to be an alternative substrate to carbohydrates during endurance exercise.⁵⁰

It has been demonstrated that ketone supplements have a high incidence of GI symptoms, such as nausea, abdominal cramps, diarrhea, dizziness, and vomiting. However, there is a lack of evidence on long-term safety of ketone supplements.^{49; 50}

5. Sports Injuries

Sports injuries, such as sprains, strains, head injuries, dislocations, and fractures, are common causes for seeking advice from pharmacists. Although many sports injuries can be managed with resting, ice, compression, elevation, and treatment with local or oral anti-inflammatory drugs, others can be more serious requiring further assessment.⁵¹

Prior to treating an injury comes preventing one. At the beginning of the preseason, a preseason examination is carried out, which turns out to be an opportunity to diagnose and rehabilitate old injuries and thereby prevent reinjury. This prevention is only effective when the patient history is accurate and the physician performing this examination diagnoses correctly and advises appropriate rehabilitation programs.⁵² A traditional model for injury prevention programs in sports can be applied, involving four stages. It starts with establishing the extent of the sports injury problem, followed by establishing the etiology and mechanisms of the injury, then introducing the preventive measures, and finally assessing the effectiveness of the preventive interventions by repeating the first step.⁵³ Another injury preventing measure taken is to remove environmental risks through effective safety regulations. However, for this complicated process to become a successful intervention, it requires an understanding of the factors involved in injuries, epidemiology, the design and its implementation and monitoring of the effects of the intervention, as well as the social context of trying to prevent serious injuries. There are six potential mechanisms for reducing injuries through changes in the sports environment. The first is the above mentioned preseason medical evaluation, which has the goal to identify conditions that could be worsened by sports participation and musculoskeletal problems that can be rehabilitated before returning to sports. Medical coverage at sporting events is also one of the mechanisms to help avoid critical injuries. Although it has not been demonstrated that the presence of a healthcare team reduces the number of injuries, it provides the opportunity for a prompt diagnosis, treatment and if necessary, immediate rehabilitation, helping to prevent worsening of the injury. Coaching style is a key to this prevention, due to its influence on the athlete's motivation, self-esteem, and moral values. An adequate hydration is fundamental to reduce the rate of heat-related injuries. A relatively high percentage of sports injuries can be avoided with proper officiating, penalizing athletes whenever fair according to the sport regulations. The last mechanisms are field conditions and proper equipment, being an important part of sports safety to prevent injuries.⁵² Monitoring training load has a wide range of different purposes, being one of them injury prevention. An athlete who cannot respond to the training load, enters a stage of fatigue and has a higher risk of injury.⁵⁴

When managing an injury, a nonpharmacological treatment associated with a pharmacological treatment is the most common option. A nonpharmacological treatment alleviates symptoms and helps restore functionality with a combination of rest, ice packs, compression, and elevation for the first two days, in order to reduce inflammation. Complete inactivity is not recommended; maintaining a light training, avoiding moving or straining the affected joint or muscle, is often advised. When ice packs are applied, they cause the constriction of the local cutaneous and subcutaneous capillaries reducing the blood flow to the area, consequently restricting the transport of inflammatory markers, and reducing inflammation, pain and swelling. After this cryotherapy, compression bandages must be applied, not too tight to allow for sufficient circulation. When the affected area is elevated above the heart it utilizes gravity to help reduce the edema.^{51; 52; 55}

Nonsteroidal anti-inflammatory drugs (NSAIDs) have long been considered as first-line pharmacological treatments for pain relief and inflammation. For muscle spasm, muscle relaxants can be used, however only for a short period of time. The NSAIDs properties are mediated through the inhibition of cyclooxygenase 1 and 2 (COX-1 and COX-2) enzyme, responsible for the conversion of arachidonic acid to prostaglandins and thromboxanes. COX-1 is found in the kidney, gastrointestinal (GI) mucosa, and platelets, that maintains renal blood flow, GI cytoprotective factors, and platelet aggregation. COX-2 is found in the brain and kidney, and it becomes measurable in macrophages, gastric epithelium, vascular endothelium, and fibroblast-like synoviocytes, when induced by inflammatory mediators. The oral administration of NSAIDs might provoke adverse effects, such as nausea, diarrhea, abdominal pain, and headaches. It also presents gastrointestinal toxicity and renal adverse events that are mainly associated with long-term use, although high-risk patients may be affected even with short period of use. High-risk patients are considered people who have an excessive alcohol consumption, concomitant use of aspirin or chronic corticosteroid, use of anticoagulant or bleeding tendencies, and previous history of peptic ulcer disease. The treatment with NSAIDs should be used for a maximum of five days. The adverse effects caused by oral NSAIDs can be avoided using topical analgesic agents, since the local application reduces systematic absorption. However, adverse effects may still occur, including bronchospasm, dyspepsia, nausea, diarrhea, and local irritation. The act of massaging while applying the topical agent increases blood flow stimulating the nerves, resulting in a reduction of pain sensation.^{51; 56}

Team physicians occasionally rely on narcotic analgesics to control the pain caused by an injury. This class of substances is normally used to relieve pain, sedate, and induce sleep, and when used for a long period can cause habituation or addiction. Narcotic analgesics work

by binding to opioid receptors, present in central and peripheral nervous system. The receptors facilitate the opening of the potassium channels, causing hyperpolarization, or inhibit calcium channel opening, inhibiting the release of excitatory neurotransmitters, in order to reduce neuronal excitability in the pain-carrying pathway. The most common side effects include nausea, constipation, sedation, dizziness, vomiting, respiratory depression, physical dependence, and tolerance. As previously mentioned, narcotic analgesic medication can cause dependence and tolerance, provoking the necessity of increasing the dosage to achieve the same degree of analgesic effect. The physical dependence is caused by the continued use of this medication during several weeks which may result in withdrawal symptoms, such as irritability, anxiety, muscle pain, nausea, diarrhea, and vomiting.⁵⁶

Extreme training can cause an increase of allergies, asthma, and stress injuries and the pharmacological management of these situations has to comply with antidoping regulations. The medicines used to treat these conditions may also have potential side effects that may affect athletes' exercise performance. This extreme training predisposes athletes to viral infections more commonly than bacterial infections. However, it has been reported that athletes are prescribed oral antibiotics at almost twice the rate of the general population. The excessive consumption of antibiotics should be avoided not only due to antibiotic resistance but also gastrointestinal disturbance and diarrhea as side effects. It has been reported that tendon injuries can also be caused by the use of antibiotics, such as fluoroquinolones.^{57; 58}

6. The Pharmacist Role

6.1. Pharmaceutical Care

Pharmaceutical care is described as the integrated action of the pharmacist with the healthcare team, centering their action on the patient, promoting, protecting, recovering, and preventing diseases related to the use of medicines. It is part of the set of clinical actions that involves other health professionals in a multidisciplinary work, focusing on the patient with the main purpose of treating situations associated or not with pharmacotherapy. One of the most important service a pharmacist can provide is a pharmacotherapeutic follow-up service, since it can identify all the problems related to the pharmacotherapy and propose a resolution or prevention of these problems.¹⁶

Sports pharmacists can become an integral part of athletic healthcare, collaborating with doctors, coaches, physiotherapists, amongst others, by providing medication support, anti-doping advice and player care.⁴ Since a significant proportion of athletes and trainers lack

the knowledge regarding the medications, supplements, and substances in general they use, they often turn to primary healthcare providers, like general practitioners (GPs) or community pharmacists, for guidance to avoid unintentional doping.¹⁰ Pharmacists who collaborate with athletes play a crucial role in preventing inadvertent use of prohibited substances. As valued members of interdisciplinary healthcare teams, pharmacists bring additional expertise that contributes to the development of exceptional health practices. Their profound understanding of medications should make pharmacists integral in the field of athletic healthcare. The world of sports stands to benefit significantly from the wealth of knowledge that pharmacists possess, awaiting the opportunity to demonstrate their expertise.⁴

At large sports events, such as the Olympics and Paralympics, a team of pharmacists has been created to control the pharmacy services. The key responsibilities of the head pharmacist included:^{6;59}

- Facilitating communication between the pharmacy and international medical professionals to ensure effective and timely communication
- Promoting collaboration, establishing regular collaboration with both interprofessional and intraprofessional partners
- Coordinating inspections of the pharmacy premises and venues to ensure compliance with regulations
- Providing medication information
- Developing policies and procedures that align with the legal obligations for drug management

The sports pharmacy teams at these events were responsible for several tasks. For instance, when TUE applications were presented to the pharmacy, it fell upon the pharmacist to ensure the secure storage of the forms in a locked safe until they were retrieved by the TUE Committee. The pharmacist also had the responsibility of deliver proof of receipt to the person who submitted the application. Upon approval of a TUE by the TUE Committee, the prescribing physician would proceed to draft the required prescription. Subsequently, the pharmacy, working in coordination with the prescribing team's physician and the athlete, would then proceed to dispense the prescribed medication. When medications were provided to athletes, a careful check was conducted to determine their status within the realm of sports, whether they were prohibited or permitted. If it was found that a TUE was necessary for a specific medication, the athlete would be informed and advised accordingly.^{6;59}

Some of the general responsibilities associated with the role of pharmacists in sports pharmacy are:⁵⁹

- Medication review and dispensing
- Patient counseling
- Drug information
- Assist athletes in assessing medications on the WADA Prohibited List, receive TUE applications, and ensure compliance with the Needle Policy
- Collaboration with Sports Organizations
- Propose medication substitutions for substances that are banned or not on the formulary
- Supply and storage management
- Dispense and deliver controlled medications at competition sites, especially for athletes at a high risk of injury
- Organize daily reporting of data for a pharmacy vigilance system
- Understanding the patient population

These responsibilities encompass the multifaceted role of pharmacists in sports pharmacy, focusing on medication management, athlete support, regulatory compliance, and the well-being of athletes and non-athletes.⁵⁹

6.2. Doping Control

WADA establishes and defines the doping control process, which includes well-defined rights and responsibilities. The primary objective is to ensure that doping controls consistently meet high-quality standards. This uniformity in the process is upheld, regardless of the location or timing of the testing. The fundamental purpose of these tests is twofold: to identify and discourage doping among athletes, to preserve the integrity of clean and fair sports.⁶⁰ As the main objectives are to ensure a fair and equitable competition while protecting the health and safety of the athletes, the sports pharmacist role presents several opportunities and responsibilities including educating, advising, dispensing, and monitoring medications and supplements, while working with anti-doping agencies and their anti-doping programs in addition to prevent athletes from inadvertently using banned methods or substances. The education responsibility is not only directed to athletes at any level of competition, but it can also be to the public in general, explaining the dangers and consequences of doping.^{5; 6; 16} Pharmacists can also act as doping control officers (DCOs) and work with any sports-

governing agencies. This role can demonstrate the knowledge a pharmacist has about drugs and supplements when they are asked to revise this part of the medical history of the athlete, and they can also be consulted, by sports organizations, regarding the policy of which substances to ban or permit, due to the pharmacist knowledge of pharmacology.⁵

The DCOs are required to provide proper identification and must strictly follow the regulatory guidelines. A crucial aspect of their role is to explain the testing procedure to the athletes being tested, addressing any questions they may have. This approach is vital to uphold the rights of athletes. During the testing process, DCOs are also expected to consider the personal needs of the athletes to the extent allowed by the applicable regulations and the specific conditions at the testing location. This ensures that the testing process is conducted with respect for the individual circumstances of the athlete.⁶¹

Pharmacists can serve as DCOs within the doping control process. Additionally, they can undergo training to become volunteer chaperones, individuals who are responsible for accompanying athletes throughout the doping control procedure. This participation allows pharmacists to contribute actively to the integrity and fairness of sports by ensuring the proper execution of doping tests and safeguarding athletes' rights during the process. DCOs collaborate directly with athletes to collect urine and other body fluids samples for testing purposes. Their responsibilities encompass various aspects, such as planning and overseeing the distribution of tests, including athlete selection and notification. DCOs are also responsible for coordinating and supervising the testing process conducted by doping control testing teams. Furthermore, they may identify suitable occasions for conducting outreach programs, educating athletes, managing sample collection, handling doping control paperwork, and supporting academic research in this field. When a pharmacist is trained to be a DCO, they play a vital role in ensuring that the steps in the doping control process are meticulously followed, contributing to fairness and transparency in the testing procedures.⁶²

During the sample collection process, athletes are required to complete a Doping Control Official Record. In this record, athletes declare all substances they have used, including medications, dietary supplements, topical treatments, illicit substances, and any other relevant declarations. They must specify the name of the substance and the method of administration. It is essential to recognize that the presence of a prohibited substance in an athlete's body is just one aspect of doping. These also include:⁶²

- Attempted use or possession of a prohibited substance
- Refusal to take a test or being unavailable during the required timeframe

- Manipulation of the sample

Furthermore, pharmacists should be familiar with the anti-doping code. This includes understanding:⁶²

- Prohibited substances trafficking
- Administration of prohibited substances
- Complicity with doping
- Prohibited association with former Athlete Support Personnel (ASP) listed by WADA, who are forbidden from working with athletes

Pharmacists involved in sports pharmacy should have a comprehensive understanding of these aspects to protect the integrity of sports.⁶²

6.2.1. Whereabouts Program

As the anti-doping tests can occur either in competition or out of competition, WADA implemented the Whereabouts Program with its signatories to accomplish a successful anti-doping program. Since certain substances are prohibited only in competition, anti-doping tests must be distinguished. In the majority of sports, the in-competition period starts twelve hours prior to the event and goes on until the end. However, when an event happens over several days, such as the Olympics, this definition does not apply, so the sports federations are responsible for setting a definition of the in-competition period. In-competition testing cannot detect certain short acting performance enhancing substances that are taken at a time shortly before a competition but long enough before testing, rendering the substance and its metabolites no longer detectable. To overcome the shortcoming of the in-competition testing programs, the out-of-competition testing was introduced. The out-of-competition testing purpose is to prevent athletes from committing anti-doping violations, so this test can be performed at any time, in almost any location and with no previous notice, turning this method into one of the most effective on doping control since athletes do not have time to cover up their possible doping activities.¹² Athletes who have been included in a Registered Testing Pool by their International or National Organizations must provide their whereabouts information each day. This Program involves web-based reporting through a web site or mobile application, aiding the athletes to easily and quickly report their whereabouts information, such as their home address, training information and location, competition schedules, personal activities and a sixty-minute period when they will be available for testing.^{12; 20; 63}

6.2.2. Athletes Biological Passport

Doping can be detected through several methods but one of the major advances over the years has been the development of the Athletes Biological Passport (ABP). The fundamental principle of the ABP is to monitor selected biological parameters over time that indirectly reveal effects of doping, instead of attempting to detect the doping method or substance.^{12: 64} This Program is formed by three distinct modules, the Hematological module, the Steroidal Module, and the Endocrinological Module.⁶⁵

The Hematological Module has the purpose of identifying the use of prohibited methods or substances for the enhancement of oxygen transport or delivery, including the use of agents who affect the erythropoiesis and any form of blood transfusion or manipulation, by collecting information on markers of blood doping.^{66: 67: 68} A common example of markers variations is the plasma variation, that is at the core of many hematological changes, and hemoglobin that is measured as a concentration, can change accordingly to plasma variations. In an athletic context these blood cells will be affected differently, leading to a misinterpretation of the ABP biomarker variation.⁶⁶ For many years, the improvement of the oxygen-carrying capacity of the blood has been a target, being one of the key factors for endurance performance, the capacity of the organism to transport oxygen to the working muscle. However, the blood transfusion technique and the misuse of recombinant human erythropoietin became part of WADA Prohibited List.^{67: 69: 70} Nowadays, the homologous blood transfusion, involving blood exchange between two compatible individuals, is detectable by flow cytometry. This method can detect up to fifty days post-transfusion of the donor blood cells in the receiver. However, it presents a risk of false negative due to similar panel of surface antigens. To lower the false negative results number, an expansion of the antigen panel and a better selection of red blood cells has been suggested. However, the autologous blood transfusion, that is when an individual stores his own blood to have it later reinfused, has not an implemented method for direct detection. The electrophoresis technique is currently applied to discriminate the recombinant human erythropoietin (rhEPO) from endogenous EPO, however it takes a longer time than expected for the analysis and the high financial cost is also a negative factor. To cope with these limitations, the indirect approach was adopted to complement the direct methods.^{70: 71}

The Steroidal Module aims to identify endogenous anabolic androgenic steroids (EAASs) when they are administered exogenously, by collecting information on markers of steroid doping in urine or serum samples. It is also an effective practice to identify urine samples that have been tempered with or exchanged with another person sample. To obtain

this module, gas chromatography mass spectrometry (GC-MS) determinations of the target of this EAASs are carried out.^{66; 68; 72}

The Endocrinological Module collects information on markers of the human growth hormone doping, aiming to identify the use of this hormone or its analogs, fragments and releasing factors, and this test also indicates the use of insulin-like growth factor-I (IGF-I).^{64; 68;}

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The possible variations in previously mentioned markers, from what is expected in a healthy physiological condition, can be attributed to doping or a medical condition.⁶⁵ Physiological variations of biological origin or resulting from an athlete's activity, may explain some of these variations.⁶⁶

6.3. Educational Opportunities

People who engage in sports and exercise frequently approach pharmacists looking for advice about a drug treatment or in general healthcare that can affect their participation in sports. This demonstrates a growing need for sports pharmacists who are specialized in sports and exercise.¹⁷

Several studies were conducted surrounding the knowledge of a pharmacist about sports pharmacy. Most of the participants in these studies believed that pharmacists have an important role in helping athletes to avoid unintentional doping and they also understand the importance of the pharmacist as a member of a sports team. However, these studies revealed that pharmacists did not possess sufficient knowledge to advise athletes.^{10; 16}

Japan Anti-Doping Agency (JADA) was founded in 2001, and in 2009 the agency introduced the Sports Pharmacist System in collaboration with the Japan Pharmaceutical Association (JPA). This JADAs accomplishment represents the certification of sports pharmacists through the creation of a system that merges the knowledge and skills of pharmacists to the field of sports and anti-doping. Within this cooperative effort, JADA focuses on upholding the values of integrity, honesty, fairness, and equity in sports, while JPA's pharmaceutical social responsibility is to unite pharmacists who oversee medical care in Japan. This pioneering system is the first of its kind globally. Establishing this partnership was a logical step in safeguarding not just athletes but also the overall well-being of society in general, given that one of the primary objectives of pharmacists is to ensure the correct and responsible utilization of medicines.^{74; 75} This initiative aimed to equip pharmacists with the necessary knowledge and skills in preparation for the Tokyo 2020 Olympic and Paralympic Games. Pharmacists who successfully completed this program through JADA were eligible to obtain a

sports pharmacist certificate and become part of a national registry that is accessible to athletes nationwide. Japan holds the distinction of being the first country to implement such a unique and structured system for credentialing and registering sports pharmacists.⁶²

The International Olympic Committee (IOC) has recently introduced the IOC Certificate in Drugs in Sport, designed specifically for healthcare professionals and other individuals involved in athlete support who require specialized expertise and comprehension of drug use in sports. This online course has the purpose of safeguarding the well-being of athletes by ensuring the safe and efficient utilization of medicines and supplements. Its primary emphasis lies in the medical facets of drug use in sports, with a particular focus on the role of healthcare professionals in preventing doping incidents. This course aims to equip students with fundamental knowledge essential for expanding their competencies and professional engagement in sports. It centers around the safe, effective, and permissible utilization of drugs and supplements within the sports context. Additionally, the course will empower students to engage more deeply in the medical aspects of TUE and antidoping programs. Graduates will also gain the confidence to assume more specialized clinical or operational roles within medical services at major sporting events.⁷⁶ This program presents the following objectives:⁷⁷

- Clinical use of drugs in sport for injury and illness
- Prevention of misuse and abuse of drugs in sport
- Safe, evidence based supplement use
- Promoting the health of the athlete through effective medicines use

In the United States the official National Anti-Doping Organization (NADO) for Olympic, Paralympic, Pan American, and Parapan American sport is the United States Anti-Doping Agency (USADA). The agency is responsible for overseeing anti-doping programs, encompassing both in-competition and out-of-competition testing, and educating athletes about their roles and responsibilities in adhering to anti-doping regulations. Additionally, they provide valuable resources for healthcare professionals, including pharmacists, who may work with athletes. USADA and its partnering NADOs interpret the Prohibited List, published annually by WADA. They offer a freely accessible search tool called Global Drug Reference Online (Global DRO) in multiple languages. Global DRO allows pharmacists to review an athlete's medical history to check for any prohibited medicines. It is also a primary resource for athletes to verify the status of their medicines regarding anti-doping regulations. Even when pharmacists are already familiar with the Prohibited List, Global DRO serves as a valuable tool to check the current status of both prescription and over-the-counter drugs. Global DRO is

continually updated and provides comprehensive information on the status of drugs, aiding athletes and healthcare staff in making informed decisions.⁷⁵

Despite the availability of effective resources, like Global DRO, to prevent doping, they cannot replace the clinical judgement of pharmacists. Therefore, it remains important for all practicing pharmacists to have some level of training in anti-doping. Unfortunately, there is still a possibility for athletes and even healthcare professionals to misinterpret information about prohibited substances or methods when lacking appropriate training. For example, while most pharmacists would correctly identify anabolic steroids, stimulants, and erythropoietin stimulating agents as prohibited substances in sports, many may not be aware that diuretics are prohibited due to the fact that they can be used as masking agents and some may not realize that some medicines are prohibited because of their metabolites. This leads to the conclusion that while valuable tools like Global DRO exist to assist in anti-doping efforts, pharmacists' training in this field is also essential to ensure an accurate interpretation and application of anti-doping regulations. This knowledge is crucial for both athletes and healthcare professionals in maintaining the integrity of sports and protect the health and well-being of athletes.⁷⁵

Although many pharmacy schools may not have a dedicated anti-doping course in their curriculum, information about drugs for enhancing athletes' performance and its misuse or abuse can be easily integrated into existing parts of the curriculum. This integration can occur within courses related to pharmacology, chemistry, and therapeutics, describing the proposed mechanism of action of these substances and how they affect athletic performance, the process of sample collection for doping control and how the prohibited methods work. Learning about the general principles of doping control, rules, and regulations, and raising awareness of doping among pharmacy graduates can be highly beneficial. Pharmacists may encounter athletes in various practice settings, and being informed about anti-doping regulations can better equip them to serve patients. Additionally, pharmacy schools should have the option to offer courses or practical experiences for students who have a strong interest in sports pharmacy. These specialized courses or experiences can provide knowledge and skills related to the unique needs of athletes, further preparing students for careers in this field.^{5; 75; 78}

The International Pharmaceutical Federation (FIP) created a compilation of educational programs in sports pharmacy (Appendix I), in order to help pharmacists and pharmacy students establish a standard and quality curriculum that will enrich pharmacy involvement in sports.⁶² Despite the list with several sports' pharmacy programs, it is still advisable to introduce educational initiatives resembling JADAs "Sport Pharmacy Project" and the IOCs

“IOC Certificate in Drugs in Sport”. These programs can offer pharmacists the necessary training and knowledge in anti-doping practices.⁷⁸

7. Conclusion and Future Perspectives

The pharmacist is the healthcare professional responsible for ensuring the safe usage of medicines, being the most appropriate professional to assist athletes with their medication needs. Doping control covers the fields of analytical chemistry and pharmacology, two fields that a pharmacist is acquainted with and one of the most capable professional to perform in the mentioned areas, demonstrating the importance of this professional in a doping control team.

Currently, there are few established educational opportunities, so future initiatives focused on the education of pharmacists/pharmacy students and the professional regulation are a requirement to develop the field of sports pharmacy and promote the incorporation of pharmacists in multidisciplinary sports healthcare teams. The integration of pharmacists on these teams can complement the actions of physiologists, nutritionists, and physicians, that can optimize the use of substances when necessary, and prevent possible damages to athletes.

Sports pharmacy, as an emerging area, needs to be developed. In Portugal, at the moment, there are not many educational opportunities related to this field. The incorporation of a chapter about doping, sports supplements or sports injuries on the MSc Pharmaceutical Sciences or a postgraduate course to specialize pharmacists in the sports field can be a step in bringing pharmacists closer to this goal.

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Appendix

Appendix I – Sports Pharmacy education examples⁶²

Country	University/School of Pharmacy	Course title(s)	Course description
Undergraduate electives			
Australia	University of Tasmania College of Health and Medicine School of Pharmacy and Pharmacology	Sport Doping, Performance Enhancing Drugs and their Detection	Overview of the socio-political aspects of drug use in sports, recognizing drug classes that may enhance athletic performance and the legal and ethical issues of sports doping detection.
Korea	Korean Anti-Doping Agency	KADA Anti-doping	Online lectures and in-person programmes on anti-doping offered to healthcare professionals, young elite athletes and sport trainers.
Norway	University of Oslo	Sports Pharmacy and Anti-Doping	Introduction to use of medicines for athletes in relation to anti-doping rules, focusing on the pharmacist's role in avoiding inadvertent doping or complacency of doping.
Qatar	Qatar University College of Pharmacy	Drugs in Sport	Introduction to use of medicines for athletes in relation to health care of athletes, anti-doping rules and governance
Turkey	Anadolu University Faculty of Pharmacy	Sports Pharmacy	An elective semester course in sports pharmacy.
Turkey	Lokman Hekim University Faculty of Pharmacy	Sports Pharmacy	Integrative elective course including lectures from the National Olympic Committee, Turkish Anti-Doping Commission manager and lab, physicians, International Olympic Committee certified sports nutritionist, an associate professor of sports science, various departments of sports ministry, pharmacy law, experts of prostheses care and athlete health, and from sports scientists who are also athletes themselves.
United Arab Emirates	Gulf Medical University College of Pharmacy	Drugs in Sport	Introduction to use of medicines for athletes in relation to health

			care of athletes, anti-doping rules and governance.
United States	Palm Beach Atlantic University School of Pharmacy	Sports Pharmacy Advanced Pharmacy Practice Experience	Elective rotation for pharmacy students to apply didactic knowledge of pharmaceutical sciences and clinical pharmacy practices to understand therapeutic use or potential abuse of drugs and supplements by athletes.
United States	University of Colorado United States Anti-Doping Agency (USADA)	Anti-Doping Advanced Pharmacy Practice Experience	(Archived/not currently available.) Elective rotation for pharmacy students to spend six weeks learning the policies and procedures of USADA, including introduction to the WADA Prohibited List, athlete resources, doping control, and developing monographs of drugs as substances for possible addition to the Global Drug Reference Online platform.
United States	University of Mississippi School of Pharmacy	Drugs and Human Performance	Exploring scientific evidence and lore of drugs used with the intent for cognitive enhancement, sexual endurance and athletic performance, preparing community pharmacists to address these topics in practice or in private, including the process for athletes' legitimate medical use of prohibited drugs.
United States	West Coast University	Sports Pharmacy	Elective course in therapeutics and pharmaceutical care in sports. Topics include sports focus on asthma, glucocorticoids and other performance-enhancing drugs, medical implications of the WADA Prohibited List. Also, exercise in patients with metabolic syndrome, nutrition in sports, brain injuries, musculoskeletal injuries and pain management.
Masters of sports pharmacy			
Turkey	Lokman Hekim University Faculty of Pharmacy	Master of Sports Pharmacy	Beginning in 2022, a two-year degree programme began in-house to allow study of the full scope of sports pharmacy, covering anti-doping, nutrition, operations, sports medicine and clinical care. This course also collaborates with veterinary pharmacy, forensic

			pharmacy and traditional complementary medicine practice.
Professional certificate courses or continuing education and professional development in sports pharmacy			
Online	International Olympic Committee (IOC) administrated by Sportsoracle, an organisation that delivers online programmes on behalf of the IOC	IOC Certificate in Drugs in Sport	Expert lecturers offer healthcare professionals; clinical use of drugs in sport for injury and illness; prevention of misuse and abuse of drugs in sport; safe, evidence-based supplement use; promoting the health of the athlete through effective medicines use.
France	International Council of Sport Science and Physical Education University of Paris Nanterre	Master in Doping Studies and Analysis of Anti-Doping Policies	A hybrid programme, online and in-person offered to international students interested in anti-doping policy and research in doping.
India	Delhi Pharmaceutical Sciences and Research University Academy of Sports Science and Research Management	Diploma course in Sports Pharmacy	Taught by pharmacists, physiotherapists and other faculty members, this two-year course is for sports scientists, coaches or players to learn sports and exercise science, to increase awareness of athletes' therapeutic use or doping use of substances.
Japan	Japanese Anti-Doping Agency	Play True 2020 Sports Pharmacist System	National campaign to train pharmacists in anti-doping to ensure readiness for Tokyo 2020 Olympic Games and improve athlete access to competent pharmacists who are registered as sports pharmacists.
Turkey	Lokman Hekim University	Current Developments in Sports Pharmacy Training Programme	Online session providing an overview of the development of undergraduate course and master degree programme in sports pharmacy.
Online	International Sports Pharmacists Network	Clinical Pearls in Sports Pharmacy	An online sports pharmacy resource developed by experts offering documents and lectures for pharmacists and students who plan to work with athletes in clinical settings.
Online	International Sports Pharmacy Symposium	2021 Entrepreneurs in Sports Pharmacy	Multi-national conference hosting webinars and networking sessions for pharmacists practicing as sports pharmacy specialists, students of sports pharmacy, and sports pharmacy supporters.

		<p>2022 Pharmacy Volunteerism at Sporting Events</p> <p>2023 Sports Pharmacy Education</p> <p>2024 Athlete Perspective for Sports Pharmacists</p>	
International	World Anti-Doping Agency Anti-Doping Education e-Learning	ADEL for Medical Professionals	Clean sport education designed for healthcare professionals, including pharmacists, who work with athletes, to encourage pharmacists to provide accurate anti-doping advice to positively influence athletes' values and behaviors.