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Аналитическая справка
для формирования политики в области здравоохранения

Анализ реализации Государственных программ развития здравоохранения Республики Казахстан с 1998 по 2024 годы

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Резюме
Ключевые положения

Опыт развития здравоохранения Республики Казахстан (РК) наглядно демонстрирует плюсы и минусы перехода от бюджетного финансирования к смешанной модели с внедрением рыночных механизмов распределения ресурсов. В результате внедрения обязательного социального медицинского страхования доля расходов на здравоохранение в общем объеме ВВП увеличилась с 2,8% в 2019 году до 3,7% в 2022 году, то есть суммарно показав рост с 1 трлн. тенге до 2,5 трлн тенге. Это положительно отразилось на основных качественных показателях отрасли. Ожидаемая продолжительность жизни выросла с 66 лет в 2000 году и уже к 2024 году превысила 75-лет. Общая смертность неуклонно снижается с 2006 г. В 2014 г. впервые за годы независимости показатель был ниже 8 на 1000 населения, в 2018 г. составил 7,1‰, а в 2022 году - 6,77.

Несмотря на значительные демографические потери в конце 90-ых и начале 2000 годов (уменьшение числа жителей страны с 16, 6 млн. в 1995 году до 14,8 млн. в 2001 году), республике удалось не только стабилизировать ситуацию, но и добиться динамичного и последовательного увеличения численности населения, которая уже к 2024 году достигла 20 миллионов человек. Этому способствовали принятые масштабные комплексные меры по снижению смертности и увеличению рождаемости. Однако, по мере развития здравоохранения и внедрения современных международных технологий диагностики и лечения Казахстан начал испытывать те же проблемы, что и страны с развитой экономикой. Увеличение ожидаемой продолжительности жизни увеличили долю пожилого населения в обществе, что с свою очередь стало причиной роста заболеваемости неинфекционными болезнями, лечение которых требует и дальше будет требовать значительных финансовых вливаний.

Помимо этого, с развитием медицины постоянно растет спрос населения на высокотехнологичные виды медицинской помощи и лекарственных средств, а широкое привлечение частного сектора и развитие конкуренции уже сегодня вынуждает лимитировать объем плановых медицинских услуг. Эти и другие причины прицельно указывают на необходимость поиска внутренних резервов отрасли, перехода к ресурсосберегающим технологиям и главное – усиление роли первичной медико-санитарной помощи и развитие профилактической медицины.

В чем заключается проблема?

1. Отсутствие в отрасли системного анализа исторического развития здравоохранения РК. За все годы независимости здравоохранение страны прошло ряд институциональных реформ, кардинально менявших устоявшуюся парадигму функционирования системы в целом. Некоторые из них были весьма успешными, а некоторые так и не нашли поддержку в обществе и самой системе. Данная статья поднимает эту тему и создает основу для будущих фундаментальных исследований. Это особенно актуально для принятия управленческих решений в настоящем и будущем, так как и позитивные и негативные результаты реформ должны стать базой для разработки новых организационных решений.

2. Отсутствие в стране системы оценки результатов проведенных реформ. Помимо масштабных реформ в отрасли регулярно принимаются решения, устанавливающие нормы поведения участников. Поскольку медицина относится к сфере обеспечения жизнедеятельности и социального благополучия граждан, то жизненно необходимо иметь инструменты и механизмы оценки их эффективности. Данную статью можно расценивать как первый аналитический материал по решениям с позитивным эффектом.

3. Проблема слабой преемственности реформ. Необходимо отметить, что ряд реформ в республике были приняты без учета опыта прошлых лет и возможностей отрасли, что привело к негативным последствиям. В этих условиях актуальным становится наличие аналитической базы данных реформ с положительными и отрицательными результатами, которые должны лечь в основу будущих реформ. Именно на основе этих данных в статье даются рекомендации по основным направлениям дальнейшего развития отрасли на ближайшие годы.

Варианты политики: *Вариант 1. Улучшение доступности медицинских услуг; Вариант 2. Модернизация инфраструктуры здравоохранения; Вариант 3. Улучшение управления и контроля за расходами на здравоохранение.*

Видение по реализации вариантов политики

Правительство РК предпринимает шаги для обеспечения доступности медицинской помощи для всех граждан, включая отдаленные и сельские районы. В рамках государственных программ развития здравоохранения строятся новые медицинские

учреждения и реализуется программа "Доступная медицина", которая предусматривает мобильные медицинские бригады, доставку лекарств и технического оборудования в отдаленные районы.

Правительство РК активно работает над модернизацией существующих медицинских учреждений и строительством новых больниц. В рамках государственных программ развития здравоохранения предусмотрены средства на реконструкцию и обновление медицинских учреждений, а также на закупку современного медицинского оборудования.

Правительство принимает меры для повышения эффективности и прозрачности системы здравоохранения. Введены новые нормативы и правила финансирования медицинских учреждений, а также внедряются электронные системы учета и контроля расходов. Также проводится работа по борьбе с коррупцией в сфере здравоохранения и обеспечению ответственности медицинских работников за качество оказываемых услуг.

Ключевые слова: система здравоохранения, развитие, государственные программы.

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Введение

Этапы становления и развития здравоохранения Республики Казахстан (РК) прошли через ряд масштабных реформ, продиктованных экономическими и социальными условиями соответствующего периода страны. Казахстан, как и все страны постсоветского пространства, унаследовал затратоемкую, технически отсталую модель здравоохранения, ориентированную исключительно на бюджетные ассигнования.

Анализируя итоги всех реализованных госпрограмм необходимо отметить, что каждая из них в целом положительно отразилась на показателях здоровья населения.

Зависимость успешности реформ и мероприятий в системе здравоохранения от финансовой обеспеченности прослеживается на протяжении всего периода преобразования здравоохранения за годы независимости Казахстана, что позитивно сказалось на качественном улучшении медико-демографических показателей страны.

Казахстану удалось модернизировать систему здравоохранения, построить современные объекты, отвечающие лучшим международным стандартам, изменить устоявшуюся парадигму финансирования

и внедрить обязательное социальное медицинское страхование (ОСМС), основанное на солидарном принципе финансирования за счёт государства, работодателя и граждан.

Однако, вкладывая значительные средства в здравоохранение и обеспечивая его эффективность Казахстан начал испытывать трудности, характерные для всех стран с быстроразвивающейся экономикой, как рост количества пациентов с неинфекционными заболеваниями, старение за счет увеличения ожидаемой продолжительности жизни, растущий спрос населения на новые медицинские технологии и другие.

Меры дальнейшего развития здравоохранения требуют масштабных организационных мер и межсекторального взаимодействия, чего трудно достичь в рамках концепции или национального проекта и учитывая результаты реализации прошлых государственных программ требуется разработка и принятие новой Государственной программы развития здравоохранения на 2025-2030 годы [1].

Описание проблемы

По мере развития рыночных отношений в экономике страны и развития конкуренции во всех сферах медицинская отрасль оказалась неэффективной и неконкурентоспособной, что потребовало принятия кардинальных мер для доведения уровня отечественного здравоохранения до международных стандартов.

За годы независимости РК в целях реформирования и развития отрасли были разработаны и реализованы 5 государственных программ и национальный проект «Качественное и доступное здравоохранение для каждого гражданина «Здоровая нация» [2]. Каждая из программ

завершена с различной степенью успешности и достижения намеченных целей и результатов.

Каждая госпрограмма отвечала вызовам своего периода действия. Если первые программы преследовали цель сохранения минимального, достаточного уровня функционирования всей системы, то последующие реформы уже решали задачи улучшения материально-технического оснащения, ресурсного наполнения и развития отрасли.

Необходимо отметить, что до 2010 года отрасль сохраняла исключительно бюджетную модель и динамичный рост экономики страны позволял ежегодно увеличивать объемы финансирования в зависимости от возможностей бюджета, в зависимости от налоговых и иных поступлений.

Однако, экономические кризисы конца 90-ых и 2008 годов наглядно продемонстрировали уязвимость бюджетной модели, особенно в части контроля социально-значимых заболеваний. Еще одним важным недостатком модели является низкое качество оказываемых услуг из-за отсутствия конкуренции.

Учитывая эти факты, было принято решение по переориентации всей системы на рыночные принципы и в стране успешно была внедрена Единая национальная система здравоохранения [3], главным результатом которой стал перевод принципов финансирования отрасли с бюджетных программ на результат. За 5 лет реализации государственной программы в отрасли внедрены прогрессивные механизмы финансирования, положившие начало к внедрению конкуренции в здравоохранении и переходу на новую модель с обязательным медицинским страхованием.

Ожидаемая продолжительность жизни, являющаяся одним из основных индикаторов социально-экономического и демографического благополучия населения в современном мире, выросла с 66 лет в 2000 году и уже к 2024 году превысила 75-летний рубеж (Рисунок 1)[4].
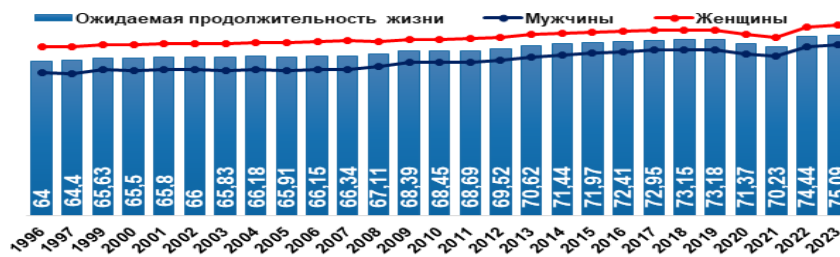
Рисунок 1 - Ожидаемая продолжительность жизни за период 1996 - 2023 годы

Общая смертность после некоторого повышения в середине 1990-х гг. и в начале 2000-х гг., почти неуклонно снижается с 2006 г. В 2014 г. впервые за годы независимости показатель был ниже 8 на 1000 населения, в 2018 г. составил 7,1‰, а в 2022 году - 6,77 ‰ (Рисунок 2,3,4) [5].

Рисунок 2 - Смертность от БСК за период 2005 - 2023 годы

Снижены показатели смертности от заболеваний, входящих в первую тройку причин смертности населения. К примеру, в 2008 году причинами свыше половины (50,3%) смертей казахстанцев были болезни системы кровообращения. В последующие годы их доля существенно снизилась, что является прямым следствием реализации программы по улучшению кардиологической и кардиохирургической помощи в стране.
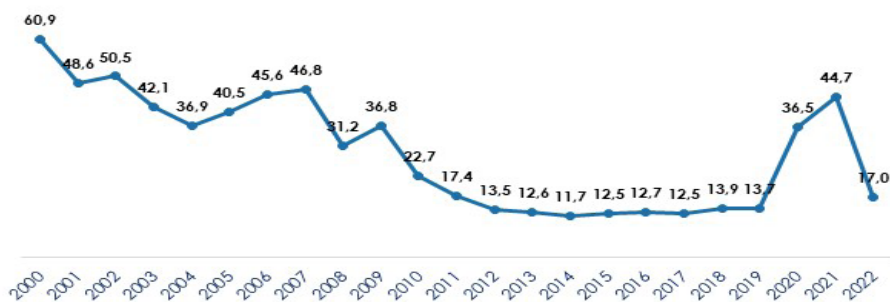
Рисунок 3 - Материнская смертность в Казахстане за период 2000 - 2022 годы

Важно отметить, что Казахстан одним из первых среди стран постсоветского пространства освоил технологию по пересадке донорского сердца и внедрил технологии пересадки искусственного сердечного желудочка.

Если в начале 2000-х годов в стране проводилось около 200 вмешательств на сердце, то на сегодня проводится уже более 100 тысяч кардиохирургических операций и интервенционных вмешательств [6].

Достигнутый за последние годы прогресс по уровням материнской и младенческой смертности является результатом внедрения с 2011 года эффективных перинатальных технологий Всемирной организации здравоохранения (ВОЗ),

которые были расширены в масштабах всех регионов страны [7].

Благодаря становлению и развитию трансплантологии с 2012 по 2022 год количество органных трансплантаций выросло в 7 раз. С 2010 года проведено свыше 1100 трансплантаций гемопоэтических стволовых клеток (ТГСК) или трансплантаций костного мозга - ТКМ) пациентам с онкогематологической патологией, в том числе более 400 - детям (Рисунок 5).

При этом, согласно расчетам, проведенным по эпидемиологическим показаниям и пролеченным случаям, потребность в ТГСК в стране только взрослым пациентам около 1000 в год [8].

Рисунок 4 - Младенческая смертность в Казахстане за период 2000 - 2022 годы

В настоящее время в РК доступны 80 видов высокотехнологичной медицинской помощи.

Несмотря на значительные демографические потери в конце 90-ых и начале 2000 годов (уменьшение числа жителей страны с 16, 6 млн. в 1995 году до 14,8 млн. в 2001 году), благодаря принятым комплексным мерам удалось не

только стабилизировать ситуацию, но и добиться динамичного и последовательного увеличения численности населения, которая уже к 2024 году достигла 20 миллионов человек [4].

Этому способствовали, в первую очередь, снижение смертности и увеличение рождаемости (Рисунок 6).
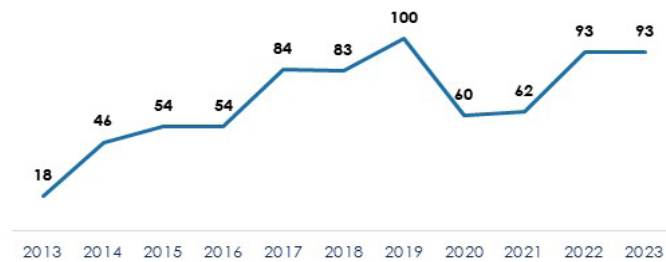
Рисунок 5 - Динамика количества трансплантаций и общая выживаемость пациентов с ТГСК и ТКМ

Несмотря на сложности этапа становления система ОСМС показала свою эффективность в период пандемии COVID-19, обеспечив гибкость

многоканального финансирования, чего была лишена бюджетная модель.

Рисунок 6 - Демографические показатели населения РК за период 1993-2021 гг.

В результате внедрения ОСМС доля расходов на здравоохранение в общем объеме ВВП увеличилась с 2,8% в 2019 году до 3,7% в 2022 году, то есть суммарно показав рост с 1 трлн. тенге до 2,5 трлн тенге [9]. При этом, количество поставщиков медицинских услуг, работающих по программе ОСМС, увеличилось с 1300 до 2000. Из них доля частных клиник выросла в два раза. В отношении высокотехнологичных медицинских услуг, расходы увеличились в 3,5 раза, с 24 млрд. тенге до 84 млрд. тенге. Объем таких услуг вырос в 4 раза.
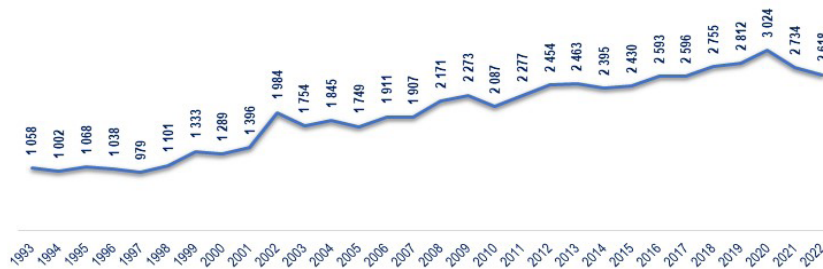
Рисунок 7 - Динамика первичной заболеваемости БСК (на 100 тыс. населения)

Учитывая средства, выделяемые через ОСМС, расходы на здоровье на одного жителя страны увеличились почти в 2,2 раза, при этом согласно данным Национальных счетов, доля частных расходов населения на оплату медицинских услуг снизилась с 33% в 2017 году до 27% в 2022 году, что составляет сокращение на 5,5% [9,10].

Так, по данным о заболеваемости болезнями системы кровообращения (БСК) рост числа пациентов составил за период 1993-2022 гг 148,4%, сахарным диабетом (СД) – 148,3%, злокачественными новообразованиями – 75,5% (ежегодно в стране регистрируется более 37 новых случаев онкологических заболеваний) (Рисунки 7,8) [11, 12, 13].

Все эти факторы требуют и будут далее требовать адекватного финансирования и принятия новых управленческих решений с учетом имеющихся реалий. Однако речь должна идти не о механическом увеличении объемов финансирования, а о внедрении в отрасли действенных инструментов ресурсосбережения с обязательной ориентацией на результат во всех направлениях выделенных финансов.
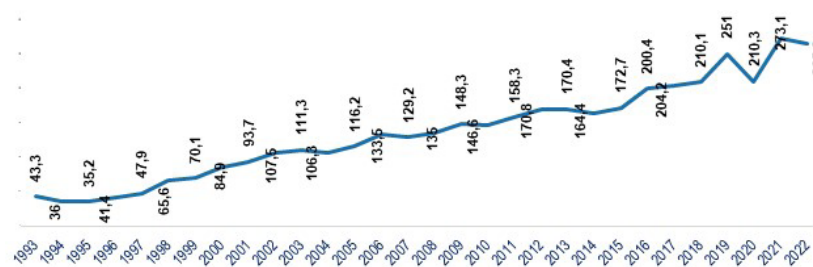
Рисунок 8 - Заболеваемость сахарным диабетом (на 100 тысяч населения)

Отмечается ежегодный рост количества больных с сахарным диабетом (до 30 тысяч случаев в год, ожидаемое количество к 2030 году – свыше 600 тысяч) [13].

В настоящее время ВОЗ (2024 год) [14] рассматривает финансирование здравоохранения как долгосрочное инвестирование, а не как краткосрочные издержки, и рекомендует внести соответствующие изменения в национальное планирование и бюджеты. Это изменение политики основано на принципах, согласно которым охрана здоровья и экономика являются взаимозависимыми, а здравоохранение является не только одним из основных секторов экономики (например, одним из крупнейших работодателей во многих странах, рынок которого оценивается более чем в 8 трлн долл. США и быстро растет), но и межсекторальным механизмом, с помощью которого можно оценить вклад многих различных секторов в охрану здоровья.

Важнейшая роль охраны здоровья проявляется в обеспечении как микроэкономической стабильности и повышении уровня благополучия и здоровья для всех, так и на макроуровне.

Пандемия COVID-19 показала, что здоровье имеет важнейшее значение для устойчивости и стабильности экономики во всем мире.

В новой экономической концепции ВОЗ, глобальная и национальная экономика и финансовые системы являются важнейшими детерминантами здоровья, значимость которых возрастает [14].

Пути решения

Перед здравоохранением страны стоят новые задачи, решение которых требует следующих мер:

Вариант 1. Переход от экстенсивной модели здравоохранения к интенсивной, с обеспечением максимальной эффективности выделенных средств с внедрением механизмов реинвестиций в отрасль за счёт улучшения администрирования и менеджмента.

Вариант 2. Переход от массовой модели здравоохранения к персонифицированной, ориентированной на нужды конкретного пациента с широким использованием возможностей цифровых технологий и искусственного интеллекта.

Вариант 3. Переход от лечебной медицины к профилактической, делая акцент на предупреждение возникновения болезней с раннего возраста использованием возможностей современных геномных технологий.

Вариант 4. Усиление научного потенциала здравоохранения с развитием нанотехнологий, регенеративной медицины и созданием условий для тесной интеграции науки и практики и научных кластеров, интегрированных с ведущими научными центрами мира.

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Түйіндеме

Түйінді ойлар

Қазақстанның денсаулық сақтауды дамытуына ресурстарды бөлу тәжірибесінің нарықтық тетіктерін енгізе отырып, бюджеттік қаржыландырудан аралас модельге көшуі оң және теріс жақтарын айқын көрсетеді. Міндетті әлеуметтік медициналық сақтандыру жүйесін енгізу нәтижесінде жалпы ішкі өнімнің жалпы көлеміндегі денсаулық сақтауға жұмсалатын шығыстардың үлесі 2019 жылғы 2,8% - дан 2022 жылы 3,7% - ға дейін, яғни 1 трлн. теңгеден 2,5 трлн теңгеге дейін ұлғайды. Бұл саланың негізгі сапалық көрсеткіштеріне оң әсерін тигізді. Өмір сүру ұзақтығы 2000 жылы 66 жастан бастап 2024 жылға қарай 75 жастан асты. Жалпы өлім-жітім 2006 жылдан бастап тұрақты түрде төмендеп келеді. 2014 жылы тәуелсіздік жылдарында алғаш рет бұл көрсеткіш 1000 тұрғынға шаққанда 8-ден төмен болды, 2018 жылы ол 7,1‰, ал 2022 жылы-6,77 құрады.

90-шы жылдардың аяғы мен 2000-шы жылдардың басында айтарлықтай демографиялық шығындарға қарамастан (1995 жылы ел тұрғындары санының 16, 6 млн-нан 2001 жылы 14,8 млн-ға дейін азаюы), республика жағдайды тұрақтандырып қана қоймай, 2024 жылға қарай 20 миллионға жеткен халық санының серпінді және дәйекті өсуіне қол жеткізді. Бұған өлім-жітімді төмендету және бала тууды арттыру бойынша қабылданған ауқымды кешенді шаралар ықпал етті.

Алайда, денсаулық сақтау саласы дамып, диагностика мен емдеудің заманауи халықаралық технологиялары енгізілгендіктен, Қазақстан экономикасы дамыған елдермен бірдей проблемаларды бастан кешіре бастады. Өмір сүру ұзақтығының ұлғаюы қоғамдағы егде жастағы халықтың үлесін арттырды, бұл өз кезегінде инфекциялық емес аурулармен сырқаттанушылықтың өсуіне себеп болды, оларды емдеу айтарлықтай қаржылық инфузияны талап етеді. Сонымен қатар, медицинаның дамуымен халықтың медициналық көмек пен дәрі-дәрмектердің жоғары технологиялық түрлеріне сұранысы үнемі артып келеді, ал жеке секторды кеңінен тарту және бәсекелестікті дамыту бүгінде жоспарлы медициналық қызметтердің көлемін шектеуге мәжбүр етеді. Осы және басқа да себептер саланың ішкі резервтерін іздеу, ресурс үнемдеуші технологияларға көшу қажеттілігін, ең бастысы – медициналық-санитарлық алғашқы көмектің рөлін күшейту және профилактикалық медицинаны дамыту қажеттігін көрсетеді.

Мәселе неде?

1. Қазақстан Республикасының денсаулық сақтау саласында тарихи дамуын жүйелі талдаудың болмауы. Тәуелсіздіктің барлық жылдарында елдің денсаулық сақтауы тұтастай алғанда жүйенің жұмыс істеуінің қалыптасқан парадигмасын түбегейлі

өзгерткен бірқатар институционалдық реформалардан өтті. Олардың кейбіреулері өте сәтті болды, ал кейбіреулері қоғамда және жүйенің өзінде қолдау таппады. Бұл мақала осы тақырыпты көтереді және болашақ іргелі зерттеулерге негіз жасайды. Бұл әсіресе қазіргі және болашақтағы басқару шешімдерін қабылдауға қатысты, өйткені реформалардың оң және теріс нәтижелері жаңа ұйымдастырушылық шешімдерді әзірлеу үшін негіз болуы керек.

2. Елімізде жүргізілген реформалардың нәтижелерін бағалау жүйесінің болмауы. Саладағы ауқымды реформалардан басқа, үнемі қатысушылардың мінез-құлық нормаларын белгілейтін шешімдер қабылданады. Медицина азаматтардың өмірі мен әлеуметтік әл-ауқатын қамтамасыз ету саласына жататындықтан, олардың тиімділігін бағалау құралдары мен тетіктері болуы өте маңызды. Бұл мақаланы оң әсері бар шешімдерге арналған алғашқы аналитикалық материал ретінде қарастыруға болады.

3. Реформалардың әлсіз сабақтастығы мәселесі. Айта кету керек, республикада бірқатар реформалар өткен жылдардағы тәжірибені және саланың мүмкіндіктерін ескерусіз қабылданды, бұл жағымсыз салдарға әкелді. Бұл жағдайда болашақ реформалардың негізін құрайтын оң және теріс нәтижелері бар реформалардың аналитикалық мәліметтер базасының болуы өзекті болып отыр. Дәл осы мәліметтер негізінде мақалада алдағы жылдарға арналған саланы одан әрі дамытудың негізгі бағыттары бойынша ұсыныстар берілген.

Саясат нұсқалары: 1-ші нұсқа. Медициналық қызметтердің қолжетімдігін жақсарту; 2-ші нұсқа. Денсаулық сақтау құрылымын модернизациялау; 3-ші нұсқа. Денсаулық сақтау шығындарын басқару мен бақылауды жақсарту.

Саясаттың нұсқаларын іске асыру жөніндегі пайым

ҚР Үкіметі шалғайдағы және ауылдық аудандарды қоса алғанда, барлық азаматтарға медициналық көмектің қолжетімділігін қамтамасыз ету үшін қадамдар жасауда. Денсаулық сақтауды дамытудың мемлекеттік бағдарламалары шеңберінде жаңа медициналық мекемелер салынуда және «Қолжетімді медицина» бағдарламасы іске асырылуда, ол мобильді медициналық бригадаларды, дәрі-дәрмектер мен техникалық жабдықтарды шалғай аудандарға жеткізуді көздейді.

Үкімет қолданыстағы медициналық мекемелерді жаңғырту және жаңа ауруханалар салу бойынша белсенді жұмыс жүргізуде. Денсаулық сақтауды дамытудың мемлекеттік бағдарламалары шеңберінде медициналық мекемелерді реконструкциялауға және жаңартуға, сондай-ақ заманауи медициналық жабдықтарды сатып алуға қаражат көзделген.

Қазақстан Республикасының Үкіметі Денсаулық сақтау жүйесінің тиімділігі мен ашықтығын арттыру үшін шаралар қабылдауда. Медициналық мекемелерді қаржыландырудың жаңа нормативтері мен ережелері енгізілді, сондай-ақ шығыстарды есепке алу мен бақылаудың электрондық жүйелері енгізілуде. Сондай-ақ денсаулық сақтау саласындағы сыбайлас жемқорлыққа қарсы күрес және көрсетілетін қызметтердің сапасы үшін медицина қызметкерлерінің жауапкершілігін қамтамасыз ету бойынша жұмыстар жүргізілуде.

Түйін сөздер: Денсаулық сақтау жүйесі, даму, мемлекеттік бағдарламалар.

Analysis of the implementation of state healthcare development programs in the Republic of Kazakhstan from 1998 to 2024

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Abstract
Key messages
The experience of healthcare development in Kazakhstan vividly demonstrates the advantages and disadvantages of transitioning from budget financing to a mixed model with the introduction of market mechanisms for resource allocation. As a result of introducing the Compulsory Social Medical Insurance, the share of healthcare expenditures in GDP increased from 2.8% in 2019 to 3.7% in 2022, amounting to a total increase from 1 trillion tenge to 2.5 trillion tenge. This has had a positive impact on major quality indicators in the industry. Life expectancy has increased from 66 years in 2000 and surpassed 75 years by 2024. Overall mortality has steadily declined since 2006. In 2014, for the first time since independence, the rate was below 8 per 1,000 population, reaching 7.1‰ in 2018 and 6.77 in 2022.

Despite significant demographic losses in the late 1990s and early 2000s (reduction in the country's population from 16.6 million in 1995 to 14.8 million in 2001), the Republic has not only stabilized the situation but also achieved dynamic and consistent population growth, reaching 20 million by 2024. This was facilitated by comprehensive measures to reduce mortality and increase birth rates.

However, as healthcare develops and modern international diagnostic and treatment technologies are introduced, Kazakhstan has begun to face similar challenges to economically developed countries. Increased life expectancy has raised the proportion of elderly people in society, leading to an increase in non-communicable diseases, the treatment of which requires and will continue to require significant financial investment. In addition, with the development of medicine, there is a constant increase in demand for high-tech medical care and pharmaceuticals. The widespread involvement of the private sector and the development of competition already necessitate limiting the volume of planned medical services. These and other reasons clearly indicate the need to explore internal industry reserves, transition to resource-saving technologies, and, most importantly, strengthen the role of primary medical and preventive care.

What is the problem?
1. Absence of systematic analysis in the healthcare sector's historical development in the Republic of Kazakhstan. Throughout the years of independence, the country's healthcare has undergone a series of institutional reforms that have fundamentally changed the established paradigm of the system's functioning as a whole. Some of these reforms have been quite successful, while others have not received support from society or the system itself. This article addresses this issue and lays the groundwork for future fundamental research. This is particularly relevant for making management decisions in the present and future, as both positive and negative reform outcomes should form the basis for developing new organizational solutions.

2. Absence of a system for evaluating the results of implemented reforms in the country. In addition to extensive reforms in the sector, the established norms of behavior for participants are regularly adopted. Since healthcare is essential for sustaining life and social well-being

of citizens, it is vital to have tools and mechanisms for evaluating their effectiveness. This article can be seen as the first analytical material on decisions with a positive effect.

3. Problem of weak continuity of reforms. It should be noted that several reforms in the republic were implemented without considering the experience of previous years and the sector's capabilities, leading to negative consequences. In these conditions, having an analytical database of reforms with positive and negative outcomes becomes crucial, forming the basis for future reforms. Based on these data, the article provides recommendations on the main directions for further sector development in the coming years.

Policy options: Option 1. Improving the accessibility of medical services; Option 2. Modernization of healthcare infrastructure; Option 3. Enhancing management and control over healthcare expenditures.

The vision for the implementation of the policy options

The Government of the Republic of Kazakhstan is taking steps to ensure access to medical care for all citizens, including remote and rural areas. Within the framework of state healthcare development programs, new medical institutions are being built and the "Accessible Medicine" program is being implemented, which includes mobile medical teams, delivery of medicines, and technical equipment to remote areas.

The government is actively working on modernizing existing medical institutions and building new hospitals. State healthcare development programs provide funds for the reconstruction and renovation of medical institutions, as well as for the purchase of modern medical equipment.

The Government of the Republic of Kazakhstan is taking measures to increase the efficiency and transparency of the healthcare system. New norms and rules for financing medical institutions have been introduced, and electronic systems for accounting and controlling expenditures are being implemented. Efforts are also underway to combat corruption in healthcare and ensure accountability of medical personnel for the quality of services provided.

Keywords: healthcare system, development, state programs.

Анализ потребления противоопухолевых препаратов, закупленных Единым дистрибьютором в рамках гарантированного объема бесплатной медицинской помощи за 2017-2019 годы

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Резюме

Управление внедрением новых, дорогостоящих противоопухолевых лекарств является непростой задачей для стран, находящихся на всех уровнях развития. С одной стороны, плательщики хотят обеспечить доступ к новым и потенциально более эффективным лекарствам, а с другой, им необходимо обеспечить финансовую устойчивость своих систем здравоохранения, соотношение цены и качества и справедливое распределение имеющихся ресурсов.

Всемирная организация здравоохранения (ВОЗ) определяет жизненно необходимые и важнейшие лекарственные средства как те, которые удовлетворяют приоритетные медицинские потребности населения. Препараты подбираются с учетом бремени болезней, доказательств эффективности и безопасности, а также сравнительной экономической эффективности.

Факторы, влияющие на доступность и использование противораковых лекарств, в определенной степени были определены и обсуждались в литературе, но имеется мало данных о фактических уровнях потребления противораковых лекарств в разных странах.

Цель исследования*: Анализ потребления противоопухолевых препаратов, закупленных Единым дистрибьютором в рамках гарантированного объема бесплатной медицинской помощи за 2017-2019 годы.*

Методы. *Анализ потребления противоопухолевых препаратов проводился с использованием ATC/DDD методологии, рекомендованной ВОЗ. Для расчета и анализа потребления использовались данные по количеству лекарственных средств, закупленных Единым дистрибьютором в рамках гарантированного объема бесплатной медицинской помощи за период 2017-2019 гг. В расчет включены онкологические препараты с кодом ATC «L01 Противоопухолевые препараты», «L02 Противоопухолевые гормональные препараты».*

Результаты. *Результаты анализа потребления онкологических препаратов с учетом способа применения показали увеличение потребления как пероральных форм онкологических препаратов группы «L01» и «L02», так и парентеральных форм. Тем не менее, преимущественное положение занимают пероральные формы противоопухолевых препаратов.*

Выводы. *Анализ потребления противоопухолевых препаратов с использованием международной ATC/DDD методологии выявила тенденции и динамику потребления противоопухолевых препаратов, что дает возможность повысить эффективность работы по оптимизации лекарственного обеспечения в онкологии. Выявлены увеличение потребления как пероральных форм онкологических препаратов, так и парентеральных форм, также определены некоторые несоответствия показаний для применения наиболее потребляемых препаратов.*

Ключевые слова*: противоопухолевые препараты, рациональное использование противоопухолевых препаратов, назначение лекарств, управление лекарственными средствами, ATC\DDD методология ВОЗ.*

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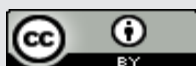Address: Kazakhstan, Astana, Beibitshilik street 49A
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Введение

Управление внедрением новых, дорогостоящих противоопухолевых лекарств является непростой задачей для стран, находящихся на всех уровнях развития. С одной стороны, плательщики хотят обеспечить доступ к новым и потенциально более эффективным лекарствам, а с другой, им необходимо обеспечить финансовую устойчивость своих систем здравоохранения, соотношение цены и качества и справедливое распределение имеющихся ресурсов [1].

Борьба с онкологическими заболеваниями является одним из ключевых приоритетных направлений социальной политики Республики Казахстан (РК). Ежегодно рак уносит 14 000 жизней [2]. В 2019 году под динамическим наблюдением в РК находилось 186 326 пациентов с злокачественными новообразованиями, из них 52,5% жили 5 лет и более [3]. В 2022 году, по данным Всемирная организация здравоохранения (ВОЗ), заболеваемость в мире достигла 19 976 499 человек (ASR World 196,6) [4].

ВОЗ определяет жизненно необходимые и важнейшие лекарственные средства (ЛС) как те, которые удовлетворяют приоритетные медицинские потребности населения. Препараты подбираются с учетом бремени болезней, доказательств эффективности и безопасности, а также сравнительной экономической эффективности [4].

Факторы, влияющие на доступность и использование противораковых лекарств, в определенной степени были определены и обсуждались в литературе, но имеется мало данных о фактических уровнях потребления противораковых лекарств в разных странах.

Различия в использовании противораковых лекарств между отдельными странами с высоким уровнем доходов были изучены в международном исследовании использования лекарств в 2008, 2009 годах и его обновлении в 2013 и 2014 годах [5,6]. В исследовании эндокринных методов лечения рака груди изучались схемы их использования в восьми западно-европейских странах и Австралии в период 2001-2012 годов [7]. За период с 1993 по 2014 год был проведен ряд сравнительных продольных исследований доступа пациентов к лекарствам от рака в Европе. В этих исследованиях рассматривались различия в расходах, а также для отдельных лекарств миллиграммы или граммы на случай и определенные суточные дозы [8,9,10]. Данные исследования показали, что наиболее важными коррелятами увеличения использования лекарств в выборке противоопухолевых препаратов, представленных за последние 15 лет, был охват лекарств с учетом времени, прошедшего с момента получения разрешения на продажу данных препаратов в Европейском союзе. Повышение цен отрицательно сказалось на потреблении, а это означает, что оно может стать препятствием для пациентов к доступу лекарств.

Целью данного исследования является анализ потребления противоопухолевых препаратов, закупленных Единым дистрибьютором (ЕД) в рамках гарантированного объема бесплатной медицинской помощи (ГОБМП), с использованием ATC/DDD методологии, рекомендованной ВОЗ [11,12].

В рамках данной статьи мы публикуем результаты анализа потребления противоопухолевых препаратов в разрезе путей введения, а также рассмотрим их потребление в разрезе отдельных препаратов по международному непатентованному наименованию (МНН) и обоснованности наличия в клинических протоколах РК (КП).

Материалы и методы

Оценка потребления противоопухолевых препаратов, закупленных ЕД в период с 2017-2019гг. проводилась с использованием ATC/DDD методологии, рекомендованной ВОЗ [11,12]. Для расчета и анализа потребления использовались данные по количеству ЛС, закупленных ЕД в рамках ГОБМП за период 2017-2019 гг., предоставленные Департаментом лекарственного обеспечения и стандартизации Министерства здравоохранения РК (ныне Департамент лекарственной политики). В расчет включены онкологические препараты с кодом ATC «L01 Противоопухолевые препараты», «L02 Противоопухолевые гормональные препараты».

ATC/DDD - методология создана с целью предоставления статистических данных о потреблении ЛС и проведения сравнительных анализов на международном уровне в рамках одного инструментария.

DDD (Defined Daily Dose) — это расчетная средняя поддерживающая суточная доза ЛС, применяемого по основному показанию у взрослых, которая является технической единицей использования.

Для расчета потребления противоопухолевых препаратов был использован показатель DID – количество DDD на 1000 человек в сутки. Калькуляция расчетов потребления с поправкой на количество жителей проводилось по формуле:

$$DID = (DDD_{s} \times 1000)/(\text{численность популяции} \times 365 \text{ (количество дней в году)})$$

Сведения о величинах DDD были получены на сайте Сотрудничающего центра ВОЗ по методологии статистики ЛС. Следует отметить, что в данной оценке рассматриваются только те ЛС, которым присвоены коды ATC и DDD.

Данные о численности населения страны за исследуемый период взяты из ежегодных статистических сборников «Основные социально-экономические показатели РК», опубликованных в интернет-ресурсе Комитета по статистке Министерства национальной экономики РК [13].

Ограничения: ЛС с завершенным кодом ATC (все значения ATC), но при этом, не имеющие DDD, рассчитаны с DID (дозы 1-ой единицы измерения). В списке ЛС, закупленных ЕД в период с 2017-2019 гг. всего 357 позиций противоопухолевых препаратов с

ATC кодами L01 и L02, что составило 13,1% от общего списка закупа. Из них, L02 «Противоопухолевые гормональные препараты» - 73 позиций, при этом доля составила 20,5% и DDD есть по всем позициям. Из группы L01 «Противоопухолевые препараты» –

284 позиций, что составило 79,5%, при этом во всех позициях отсутствует DDD. Расчет позиций без DDD группы L01 «Противоопухолевые препараты» произведен DID.

Результаты

По результатам анализа закупа лекарственных средств ЕД за период 2017-2019 гг., в 2017 году закуплено всего 737 позиций лекарственных средств, в 2018 году -1164, в 2019 году - 812. Из 737 закупленных позиций ЛС в 2017 году, противоопухолевые препараты группы «L01» составили 69 позиций (9%), а группы «L02» – 19 позиций (2,6%). Из 1164 закупленных позиций ЛС в 2018 году, противоопухолевые препараты группы «L01» составили 110 позиций (9%), группы «L02» – 36 позиций (3%). Из 812 закупленных позиций ЛС в 2019 году, противоопухолевые препараты группы «L01» составили 105 позиций (13%), группы «L02» – 18 позиций (2%) (Рисунок 1).
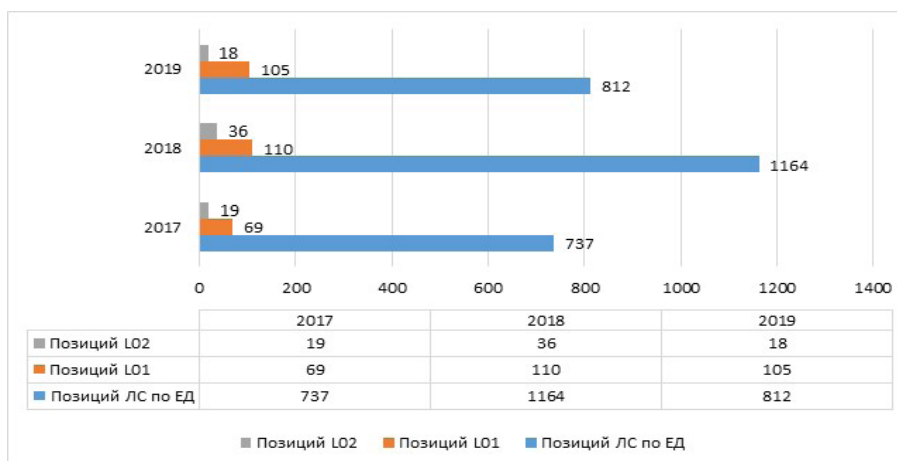
Рисунок 1 - Количество противоопухолевых препаратов групп «L01» и «L02» из списка закупа ЛС за 2017-2019 гг.

Результаты анализа потребления онкологических препаратов с учетом способа применения показали увеличение потребления пероральных форм онкологических препаратов группы «L01» в 2018 году, что составило 0,50 DID

на 1000 населения в день по сравнению с 2017 годом – 0,31, но в 2019 году наблюдается снижение показателя потребления до 0,41 DID по сравнению с показателем 2018 года.
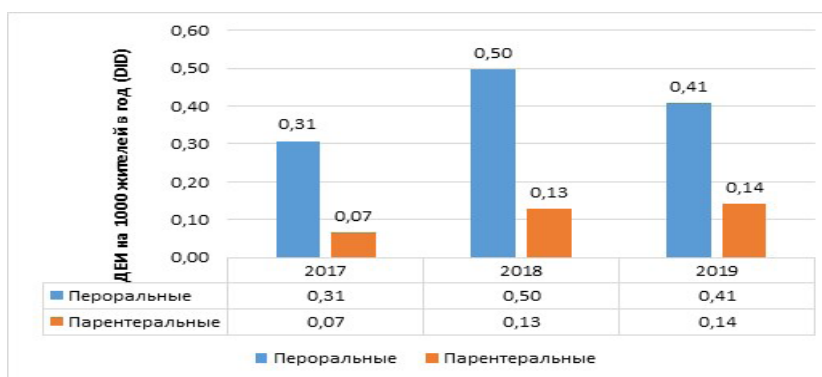
Рисунок 2 - Общее потребление онкологических препаратов (L01), закупленных в рамках ГОБМП за период 2017-2019 гг. по путям введения (DID на 1000 населения в день)

За период с 2017 по 2019 годы наблюдается неуклонный рост потребления парентеральных форм онкологических препаратов группы «L01», так в 2019 году увеличилось их потребление до 0,14 DID по сравнению с показателем потребления 0,07 DID в 2017 году (Рисунок 2). Также, наблюдается значительное увеличение потребления пероральных форм онкологических препаратов и группы «L02» в 2019 году, что составило 0,41 DDD на 1000 населения в день, по сравнению с 2017 годом – 0,13. При этом потребление парентеральных форм онкологических

препаратов группы «L02» в 2019 году значительно увеличилось до 0,18 DID по сравнению с показателем потребления 0,02 в 2017 году (Рисунок 3).

В структуре потребления онкологических препаратов группы «L01» в 2019 году лидерами стали фармакологические группы «L01X-Другие противоопухолевые препараты» и «L01B Антиметаболиты» с показателем потребления равным 0,30 (55%) и 0,21 (39%) DID соответственно.

Далее по убыванию «L01A Алкилирующие препараты», доля которых составила 3% (0,02 DID) от общего потребления, «L01C Алкалоиды растительного происхождения и другие препараты естественного происхождения» - 2% (0,01 DID) и «L01D Цитотоксические антибиотики и родственные соединения» -1% соответственно, которая стала самым наименее потребляемым в период с 2017-2019 гг.

Рисунок 3 - Общее потребление онкологических препаратов (L02), закупленных в рамках ГОБМП за период 2017-2019 гг. по путям введения (DID)

Наиболее потребляемым противоопухолевым препаратом в разрезе МНН в рамках ГОБМП за 2019 год стал Иматиниб из группы «L01X Другие противоопухолевые препараты». Потребление данного препарата выросло на 25,5% и составил 0,094 DID в 2019 году по сравнению с показателем потребления 0,070 DID в 2017 году. Далее по убыванию, наиболее потребляемыми в 2019 году стали Метотрексат, Капецитабин и Гидроксикарбамид.
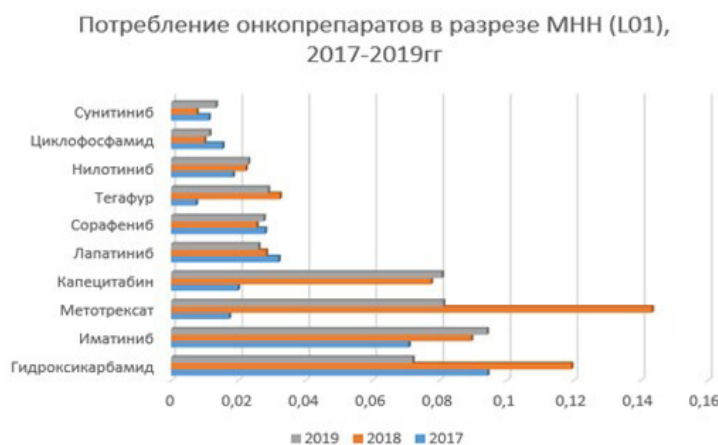
Рисунок 4 - Потребление онкологических препаратов группы «L01» в разрезе МНН за 2017-2019 гг.

В разрезе ЛС группы «L01B Антиметаболиты» наиболее потребляемыми в 2018-2019 гг. стали следующие препараты: Метотрексат, Цитарабин, Капецитабин, Гемцитабин, Тегафур. Особенно отмечается высокий рост потребления Метотрексата и Капецитабина в 2018 году. Однако в 2019 году потребление Метотрексата снизилось до 1,16 DID по сравнению с 2018 годом (1,37 DID). При этом, в 2019 году отмечается рост потребления препарата Иматиниб. Возможно, это объясняется тем, что в 2019 году Метотрексат предположительно был частично заменен на препарат Иматиниб. При этом, нет основания судить о замене препаратов, в связи с отсутствием данных по использованию препарата в разрезе определенных нозологий. Следует отметить, что Метотрексат применяется не только при онкологических заболеваниях, но и в гематологии. Тем не менее, несмотря на снижение потребления, Метотрексат в 2019 году остается лидером из группы «L01B Антиметаболиты» с показателем потребления 1,16 DID, а наименее потребляемым стал Тегафур с показателем потребления 0,03 DID.

Наименее потребляемыми в разрезе МНН в 2019 году оказались препараты Сунитиниб из группы «L01X Другие противоопухолевые препараты» и Циклофосфамид из группы «L01A Алкилирующие препараты» с показателем потребления 0,013 и 0,011 DID соответственно (Рисунок 4).

Наиболее потребляемым в разрезе МНН за 2019 год из группы L02 «Противоопухолевые гормональные препараты» стал Торемифен из подгруппы «L02BA Антиэстрогены» с показателем потребления 0,127 DID. При этом «L02BA Антиэстрогены» лидируют в 2019 году и в общей структуре потребления онкологических препаратов группы «L02».

Далее по убыванию наиболее потребляемыми из группы L02 «Противоопухолевые гормональные препараты» стали Трипторелин, Летрозол, Тамоксифен и Анастрозол с показателем потребления 0,106; 0,102; 0,088; и 0,082 DID соответственно (Рисунок 5).

Потребление онкопрепаратов в разрезе МНН, 2017-2019гг. (DID)

■ 2019 ■ 2018 ■ 2017
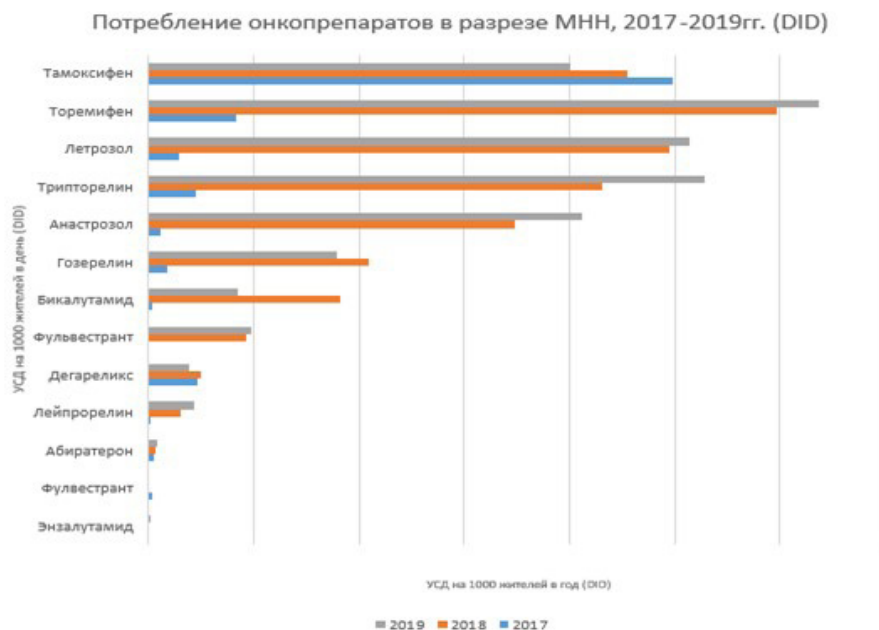
Рисунок 5 - Потребление противоопухолевых препаратов группы L02 в разрезе МНН за 2017-2019 гг.

Обсуждение

Правительства и учреждения во всем мире продолжают использовать Примерные перечни ВОЗ в качестве справочной информации для разработки своих собственных перечней основных лекарственных средств, поскольку они знают, что каждое включенное в перечень ВОЗ ЛС было проверено на предмет эффективности и безопасности и обеспечивает оптимальное соотношение цены и качества с точки зрения улучшения здоровья.

Примерные перечни обновляются каждые два года Комитетом экспертов, в состав которого входят авторитетные специалисты из научно-исследовательских, медицинских учреждений и фармацевтических компаний [14].

В Казахстане с 2009 года внедрена формулярная система, в связи с чем список жизненно-важных ЛС был расширен и принят Республиканский лекарственный формуляр, который с 2015 года перешел в Казахстанский национальный лекарственный формуляр (КНФ). Список закупа ЕД формируется на основе КНФ. Учитывая, что данное исследование анализирует данные за 2017-2019 годы, было проведено сравнение закупленных противоопухолевых препаратов с перечнем основных ЛС ВОЗ за 2019 год [15].

В перечне основных ЛС ВОЗ за 2019 год представлено 59 противоопухолевых препаратов (МНН), в том числе с кодом АТС «L01», «L02» – 48 позиций, 10 позиций с другими кодами. Из 48 позиций 44 ЛС – «L01» и 4 ЛС - «L02». Из закупленных в рамках ГОБМП в период 2017-2019 гг. 61-го противоопухолевого препарата (МНН) с кодом АТС «L01» - 33 МНН (54%) соответствуют основному списку ЛС ВОЗ, из 13 МНН с кодом АТС «L02» - 4 (31%) соответствуют основному списку ЛС ВОЗ.

Таким образом, по сравнению с количеством противоопухолевых препаратов из списка ВОЗ, в Казахстане список закупленных онкологических препаратов шире, однако соответствие наблюдается только на 54% ЛС с кодом АТС «L01», на 31 % с кодом АТС «L02».

При назначении лекарств, выбор способа введения имеет немаловажное значение для получения безопасной и эффективной терапии. Учитывая побочные эффекты и плохую переносимость химиотерапевтических препаратов, важным аспектом терапии противоопухолевыми препаратами является обеспечение безопасности пациентов. По данным научной литературы, неблагоприятные последствия, связанные с применением противоопухолевых препаратов, наблюдаются хотя бы один раз у каждого пациента [16]. В данном анализе было рассмотрено потребление пероральных (через рот) и парентеральных (инъекционных, инфузионных и др.) лекарственных форм. Результаты анализа показали, что за исследуемый период потребление пероральных форм превышает парентельные. При этом, в 2018 году рост потребления пероральных форм препаратов выше чем в 2017 и в 2019 годах.

Вопреки бытующему мнению о преимуществах перорального способа применения ЛС, многие авторы отмечают что, пациенты, получающие пероральные противоопухолевые препараты относятся к группе высокого риска по возникновению медикаментозных ошибок, например, из-за полимедикации, возраста и ограниченной приверженности к лечению [17,18].

В этой связи необходима разработка и внедрение стандартизированной программы по повышению безопасности пациентов, которым недавно были назначены пероральные противоопухолевые препараты [18]. Наряду с этим, отмечается неуклонный рост применения парентеральных препаратов. Поскольку дозировка и введение инъекционных противоопухолевых препаратов различаются у каждого пациента, проверка назначений и асептического внутривенного смешивания может быть очень сложной и отнимать много времени у фармацевтов, в связи с чем для управления рисками при использовании инъекционных противоопухолевых препаратов разработана система проверки [19], которая используется на практике.

Группа L01 «Противоопухолевые гормональные препараты» представлена пятью подгруппами: «L01X - Другие противоопухолевые препараты», «L01B Антиметаболиты», «L01A Алкилирующие препараты», «L01C Алкалоиды растительного происхождения и другие препараты естественного происхождения» и «L01D Цитотоксические антибиотики и родственные соединения». Из группы «L01X-Другие противоопухолевые препараты» наиболее потребляемым был препарат Иманитиб. По данным Британского национального лекарственного формуляра (БНФ) [20], препарат Иматиниб имеет следующие показания:

•лечение хронического миелоидного лейкоза в хронической фазе после неэффективности интерфероном альфа;

•лечение хронического миелолейкоза в ускоренной фазе или при бластном кризе;

•лечение впервые выявленного острого лимфобластного лейкоза (в сочетании с другой химиотерапией);

•монотерапия рецидивирующего или рефрактерного острого лимфобластного лейкоза;

•лечение c-kit (CD117) -положительных нерезектабельных или метастатических злокачественных стромальных опухолей желудочно-кишечного тракта (GIST);

•адъювантное лечение после резекции c-kit (CD117) - положительного GIST у пациентов со значительным риском рецидива;

•лечение миелодиспластических / миелопролиферативных заболеваний, связанных с перестройкой гена рецептора тромбоцитарного фактора роста;

•лечение неоперабельной протуберанской дерматофибросаркомы;

•рецидивирующая или метастатическая протуберанская дерматофибросаркома у пациентов, которым невозможно хирургическое вмешательство.

При этом, препарат Иматиниб в 2019 году присутствовал в следующих клинических протоколах в РК: рак молочной железы, рак легкого, рак желудка, рак шейки матки, рак толстого кишечника (Злокачественные новообразования ободочной кишки), рак прямой кишки (Злокачественные новообразования прямой кишки), рак пищевода, рак предстательной железы,

рак печени (Гепатоцеллюлярная карцинома), рак поджелудочной железы.

В Британском медицинском журнале BMJ Best Practice [21] препарат Иматиниб представлен в рекомендациях: «Острый лимфоцитарный лейкоз», «Саркома Капоши».

Таким образом, при сравнении данных отечественных клинических протоколов с показаниями БНФ в основном отмечалось несоответствие по основным показаниям. В этой связи и в связи с отсутствием данных по потреблению препарата в разрезе определенных нозологий, лидирующее потребление Иматиниба возможно было из-за нерационального применения данного препарата. Было рекомендовано провести оценку использования препарата Иматиниб на обоснованность назначений в медицинских организациях. За 2022-2024 годы практически все перечисленные выше клинические протоколы были пересмотрены и препарат Иматиниб был исключен, кроме клинических протоколов рак желудка и рак пищевода.

Группа L02 «Противоопухолевые гормональные препараты» представлена двумя фармакологическими группами «L02A Гормоны и родственные соединения» и «L02B Антагонисты гормонов и родственные соединения» и пятью подгруппами: «L02BA Антиэстрогены», «L02BG Ингибиторы ферментов», «L02AE Аналоги гонадотропин – рилизинг гормона», «L02BB Антиандрогены» и «L02BX Другие антагонисты гормонов и их аналоги». Наиболее потребляемым в разрезе МНН за 2019 год из группы L02 «Противоопухолевые гормональные препараты» стал препарат Торемифен из подгруппы «L02BA Антиэстрогены».

По сравнению с 2017 годом (0,017 DID) потребление Торемифена в 2019 году выросло более чем в 10 раз. Следует отметить, что основным показанием для применения Торемифена, в соответствии с КП РК, является рак молочной железы, который занимает лидирующие позиции в статистических данных заболеваемости и смертности среди населения РК. По данным БНФ [20], Торемифен применяется при гормонозависимом метастатическом раке груди у женщин в постменопаузе.

В Британском медицинском журнале BMJ Best Practice [21] лекарственный препарат Торемифен в рекомендациях «Рак молочной железы», «Метастатический рак молочной железы» не представлен. Таким образом, в связи с тем, что назначение Торемифена согласно международному опыту имеет узкий круг показаний к применению, лидирующее потребление Торемифена также предполагаем нерациональным. При пересмотре данного клинического протокола в 2022 году препарат Торемифен наряду с применением при гормонозависимом метастатическом раке груди у женщин в постменопаузе обозначен как основной препарат с 100% вероятностью применения.

Выводы

Таким образом, фармакоэпидемиологический анализ потребления противоопухолевых препаратов с использованием международной ATC/DDD методологии выявила тенденции и динамику потребления противоопухолевых препаратов, что дает возможность повысить эффективность работы по оптимизации лекарственного обеспечения.

Результаты анализа потребления онкологических препаратов с учетом способа применения показали увеличение потребления как пероральных форм онкологических препаратов группы «L01» и «L02», так и парентеральных форм. Тем не менее, преимущественное положение занимают пероральные формы противоопухолевых препаратов.

В разрезе фармакологических групп наиболее потребляемыми оказались препараты групп «L01X Другие противоопухолевые препараты» (Гидроксикарбамид, Иматиниб, Лапатиниб, Нилотиниб, Сорафениб) и «L01B Антиметаболиты» (Метотрексат, Цитарабин, Капецитабин, Гемцитабин, Тегафур). В разрезе МНН наиболее потребляемым препаратом из группы «L01» в 2019 году оказался Иматиниб, а в 2018 году лидировали Метотрексат и Гидроксикарбамид. Наименее потребляемыми оказались препараты Сунитиниб и Циклофосфамид.

При сравнении показаний для применения препарата Иматиниб данных отечественных КП с показаниями БНФ в основном отмечалось несоответствие применения по основным показаниям. В этой связи и в связи с отсутствием данных по потреблению препарата в разрезе определенных нозологий, лидирующее потребление Иматиниба возможно было из-за нерационального применения данного препарата.

Было рекомендовано провести оценку использования препарата Иматиниб на обоснованность назначений в медицинских организациях. За 2022-2024 годы практически все перечисленные выше КП были пересмотрены и препарат Иматиниб был исключен, кроме клинических протоколов рак желудка и рак пищевода.

Наиболее потребляемым из группы «L02» за 2019 год стал препарат Торемифен. В связи с тем, что назначение Торемифена согласно международному опыту имеет узкий круг показаний к применению, лидирующее потребление Торемифена также возможно нерациональное.

В целом по результатам анализа не наблюдается резких изменений в потреблении противоопухолевых препаратов, закупленных в рамках ГОБМП, в том числе в структуре и объеме потребления наиболее потребляемых ТОП-10 препаратов в разрезе МНН. Наиболее часто используемые противоопухолевые препараты в рамках ГОБМП закупались в соответствии с перечнем и КП. Все сравнения с КП диагностики и лечения п роводились с действующими на 2019 год.

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Бірыңғай дистрибьютор 2017-2019 жылдарға арналған тегін медициналық көмектің кепілдендірілген көлемі шеңберінде сатып алған ісікке қарсы препараттарды тұтынуды талдау

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Түйіндеме

Жаңа, қымбат тұратын ісікке қарсы препараттарды енгізуді басқару дамудың барлық деңгейіндегі елдер үшін күрделі мәселе болып табылады. Бір жағынан төлеушілер жаңа және әлеуетті неғұрлым тиімді дәрілерге қолжетімділікті қамтамасыз етуді қалайды, алайда екінші жағынан, олар денсаулық сақтау жүйесінің қаржылық тұрақтылығын, ақшаның құнын және қолда бар ресурстарды әділ бөлуді қамтамасыз етуі керек.

Дүниежүзілік денсаулық сақтау ұйымы өмірді сақтайтын және маңызды дәрі-дәрмектерді халықтың денсаулығына бірінші кезектегі қажеттіліктерін қанағаттандыратын дәрілер ретінде анықтайды. Дәрілер аурудың ауыртпалығы, тиімділігі мен қауіпсіздігінің дәлелі және салыстырмалы экономикалық тиімділік негізінде таңдалады.

Әдебиеттерде ісікке қарсы препараттардың қолжетімділігі мен қолданылуына әсер ететін факторлар белгілі бір дәрежеде анықталған және талқыланған, бірақ әртүрлі елдерде ісікке қарсы препараттарды тұтынудың нақты деңгейі туралы деректер аз.

Зерттеудің мақсаты: Бірыңғай дистрибьютор 2017-2019 жылдарға арналған тегін медициналық көмектің кепілдендірілген көлемі шеңберінде сатып алған ісікке қарсы препараттарды тұтынуды талдау.

Әдістері. Ісікке қарсы препараттарды тұтынуды талдау ДДҰ ұсынған ATC/DDD әдістемесін пайдалана отырып жүргізілді. Тұтынуды есептеу және талдау үшін біз 2017-2019 жылдар аралығындағы тегін медициналық көмектің кепілдік берілген көлемі шеңберінде Бірыңғай дистрибьютор сатып алған дәрілік заттардың саны туралы деректерді пайдаландық. Есепке «L01 ісікке қарсы препараттар», «L02 ісікке қарсы гормоналды препараттар» ATC коды бар онкологиялық препараттар кірді.

Нәтижесі. Онкологиялық препараттарды тұтынуды талдау нәтижелері «L01» және «L02» топтарының онкологиялық препараттарының пероральді түрлерін де, парентеральді түрлерін де тұтынудың артқанын көрсетті. Дегенмен, ісікке қарсы препараттардың пероральді түрлері басым орынды алады.

Қорытынды. Халықаралық ATC/DDD әдістемесін қолдана отырып, ісікке қарсы препараттарды тұтынуды талдау ісікке қарсы препараттарды тұтынудың тенденциялары мен динамикасын анықтады, бұл онкологиядағы дәрілік қамтамасыз етуді оңтайландыру бойынша жұмыстың тиімділігін арттыруға мүмкіндік береді. Онкологиялық препараттардың пероральді түрлерін де, парентеральді түрлерін де тұтынудың артқаны анықталды. Сонымен қатар ең көп тұтынылатын препараттарды қолдану көрсеткіштерінің кейбір сәйкессіздіктері анықталды.

Түйін сөздер: ісікке қарсы препараттар, ісікке қарсы препараттарды ұтымды қолдану, дәрілік препараттарды тағайындау, препараттарды басқару, ДДҰ ATC\DDD әдістемесі.

An analysis of the consumption of anticancer drugs imported by the Unified Distributor as part of the guaranteed volume of free medical care for 2017-2019

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Abstract

Managing the introduction of new, expensive cancer medicines is a challenge for countries at all levels of development. On the one hand, payers want to ensure access to new and potentially more effective medicines; on the other hand, they need to ensure that their health systems are financially sustainable, provide value for money and allocate available resources equitably. WHO defines essential medicines as those that meet the priority health needs of the population. Medicines are selected on the basis of disease burden, evidence of efficacy and safety, and comparative cost-effectiveness. Factors influencing the availability and use of anticancer medicines have been identified and discussed to some extent in the literature, but data on the actual consumption of anticancer medicines in different countries are scarce.

Objective: Analysis of the consumption of anticancer drugs imported by the Unified Distributor as part of the guaranteed volume of free medical care for 2017-2019.

Methods. Consumption of anticancer drugs was analyzed using the ATC/DDD methodology recommended by WHO. To calculate and analyze consumption, data on the number of medicines purchased by the Single Distributor within the guaranteed volume of free medical care for the period 2017-2019 were used. Oncological drugs with ATC code "L01 Antineoplastic drugs", "L02 Antineoplastic hormonal drugs" were included in the calculation.

Results. The results of the analysis of consumption of oncological drugs taking into account the route of administration showed an increase in the consumption of both oral forms of oncological drugs of the "L01" and "L02" groups and parenteral forms. However, the oral forms of antitumor drugs occupy a preferential position.

Conclusion. Analysis of the consumption of anticancer drugs using the international ATC/DDD methodology revealed trends and dynamics of consumption of anticancer drugs, which makes it possible to improve the efficiency of work to optimize drug supply in oncology. An increase in the consumption of both oral and parenteral forms of oncological drugs has been identified, as well as certain inconsistencies in the indications for the use of the most consumed drugs.

Keywords: anticancer drugs, rational use of anticancer drugs, prescribing, medicines management, WHO ATC\DDDD methodology.

Original article

Study of hospitalized cases associated with acute cerebrovascular accidents

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Abstract

Proper organization of the system for providing medical care to patients with cerebral stroke will reduce mortality and reduce the level of disability. All activities are aimed at creating unified principles of diagnostic approaches and management of patients with stroke. A significant role is given to primary prevention by optimizing the system of medical care for stroke patients. Coordinating centers for cerebrovascular pathology and stroke are being created

The purpose *of our study is to analyze cases of hospitalization of patients with acute cerebrovascular accidents from 2012 to 2022 in Almaty city.*

Methods. *A retrospective study was conducted. The data analysis period was from 2012 to 2022. The analysis data included the age of the patients, the days spent in bed, the outcome of the disease, emergency or planned admissions. Data analysis was carried out using SPSS 13 program.*

Results. *The age of patients with acute cerebrovascular accidents fluctuated within 10 years in the range of 59.8 as well as bed days was 11.46. The number of the emergency hospitalization was higher in comparison to planned; however, it was positive dynamics last five years. In addition, from 2012 the mortality rate decreased whereas recovery increased which means there are better results and accept to health facilities.*

Conclusion. *The introduction of stroke programs, as well as improvements in primary health care, have allowed us to improve care for patients. While the prevention and treatment programs still need to be continually improved, taking into account age, gender, risk factors and other factors.*

Keywords: *acute cerebrovascular accidents, stroke, hospitalization, bed-days, Kazakhstan.*

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Introduction

Acute cerebrovascular accident is one of many other pressing problems around the world with depressing rates of morbidity and mortality, as well as disability. Stroke is characterized as a neurological deficit associated with acute focal damage to the central nervous system from a vascular cause [1]. Cerebrovascular disease, which includes ischemic and hemorrhagic stroke, is the third most common cause of death worldwide, with a mortality rate of 86.5 per 100,000 person-years [2]. More than 700 thousand people suffer from stroke each year in the United States, up to 500 thousand people in Canada, up to 1 million people in the European Union, and in the world the number of cases can reach 10 million. The average prevalence of stroke is 200 cases per 100 thousand population annually, although it varies in different regions and depends on race and many other factors [3].

A systematic and meta-analysis found that over the past 40 years, the overall incidence of intracerebral hemorrhage is 29.9 per 100,000 person-years, which has not decreased worldwide, where the incidence in Asian populations is significantly higher than in other continents [4]. Another systematic review found that the cumulative incidence of intracerebral hemorrhage was highest in lower-middle-income countries [5]. Epidural hematomas are present in approximately 2% of patients with traumatic brain injury and account for 5% to 15% of fatal head injuries. The incidence of subdural hematoma is estimated to be between 5% and 25% of patients with major head trauma, while subarachnoid hemorrhage accounts for approximately 5% of all strokes and occurs in approximately 2 to 25 per 100,000 person-years among persons over 35 years of age, and also, intraparenchymal hemorrhages account for 10% to 20% of all strokes [6]. The authors note that globally in 2019, the cost of lost wealth due to stroke was $2059.67 billion, or 1.66% of global GDP; of the subtypes for ischemic stroke was $882.81 billion) for intracerebral hemorrhage was $212.36 billion US dollars, for subarachnoid hemorrhage [7].

In the Republic of Kazakhstan, strokes are in third place in terms of prevalence after diseases of the circulatory system and malignant tumors. According to statistics, in 2015, more than 40 thousand Kazakhstanis suffered a stroke, of which in 24% of cases it was fatal. The incidence in the country ranges from 2.5 to 3.7 cases per 1000 people per year, and the mortality rate ranges from 100 to 180 cases per 100 thousand people, and disability is 104.6 per 100,000 population [8].

Over the past decade, a number of programs and a road map have been introduced to improve the provision of medical care for diseases of the circulatory system, stroke, and injuries in the Republic of Kazakhstan for 2022-2023 [9]. In addition, new treatment methods have been introduced in the regions, as well as high-tech medical services to reduce deaths from heart disease, including stroke and other.

The purpose of our study is to analyze cases of hospitalization of patients with acute cerebrovascular accidents from 2012 to 2022 in Almaty city.

Methods

The analysis was carried out based on data from the Salidat Kairbekova National Research Center for Health Development in Almaty. Cases were analyzed according to International Disease Classification Code 10 (ICD-10):

• I60.0- I60.9 (Subarachnoid haemorrhage);

• I61.0-I 61.9 (Intracerebral haemorrhage);

• I63.0-I63.9 (Cerebral infarction);

• I69.0-I69.4 and I69.8 (Sequelae of cerebrovascular disease);

• I70.0- I70.2 and I70.8, I 70.9 (Atherosclerosis);

• I78.0- I78.1 and I78.8 (Diseases of capillaries).

The data analysis period was 10 years from 2012 to 2022. The analysis data included the age of the patients, the days spent in bed, and the outcome of the disease. The analysis also included data from emergency or planned admissions. Data analysis was carried out using SPSS 13 program.

The study approved at local ethics committee of the Kazakh National Medical University.

Results

Our analysis showed that the age of patients with acute cerebrovascular accidents fluctuated within 10 years in the range of 54.49 years and 61.97 years (Table 1).

Table 1 - Characteristics of patients with acute cerebrovascular accidents

Years	N	Age of patients	Bed days spent
		Mean± Std. Deviation	Mean± Std. Deviation
2012	63	54.49±25.01	10.21±9.76
2013	124	50.24±24.52	10.88±10.26
2014	142	60.2±15.38	14.09±31.66
2015	185	58.79±16.73	12.85±12.64
2016	269	61.07±14.86	11.37±8.93
2017	262	61.4±15	10.72±8.39
2018	251	61.49±15.07	11.9±8.3
2019	179	61.97±15.48	12.79±13.1
2020	89	63.34±13.29	8.63±6.95
2021	108	57.67±20.11	10.59±6.87
2022	191	59.73±13.88	10.09±6.47
Total	1863	59.8±16.84	**11.46±12.6**4

In general, it is worth noting that the number of patients in this nosology group grew from 2012 to 2017 from 63 cases to 269, after which there was a sharp decrease until 2020 (89 patients), and then increased to 191 cases in 2022. Over the course of ten years, the average bed days of hospitalized cases was 11.46 days. However, the largest number of days is observed in 2014 and 2019 (Table 1).

Cases of emergency hospitalization of patients with this category of nosology are higher than planned ones, which is due to the specifics of the disease. Nevertheless, there is a positive trend in reducing emergency hospitalization cases from 95.2 in 2012 to 53.9 in 2022. The peak increase in cases of urgent hospitalization was 99.4 in 2019 (Figure 1).
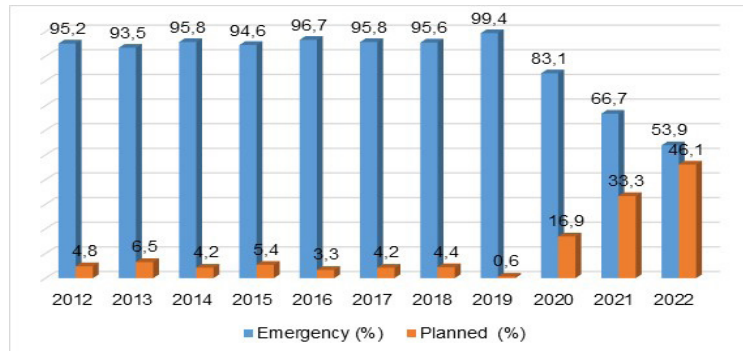

Figure 1 - Type of hospitalization from 2012 to 2022

Treatment outcome was taken into four categories as death; recovery; no change; and deterioration. The mortality rate was high in 2012 and 2013, but subsequently the dynamics changed to decrease until 2020. The decline was from 50.8% to 15.3% between 2012 and 2017, followed by an increase in 2020 to 27.0%, then a decrease to 14.7% by 2022 (Table 2).

Table 2 - Treatment outcome in four categories during 2012 to 2022

Years	Death		Recovery		No change		Deterioration	
	N	%	N	%	N	%	N	%
2012	32	50.8	29	46,0	2	3.2	0	
2013	63	50.8	58	46,8	1	0.8	2	1.6
2014	41	28.9	90	63.4	11	7.7		
2015	50	27.0	129	69.7	6	3.2		
2016	62	23.0	192	71.4	15	5.6		
2017	40	15.3	180	68.7	41	15.6	1	0.4
2018	47	18.7	189	75.3	15	6.0		
2019	38	21.2	123	68.7	18	10.1		
2020	24	27.0	59	66.3	6	6.7		
2021	22	20.4	81	75.0	5	4.6		
2022	28	**14.7**	154	80.6	9	4.7		

Regarding recovery cases, the indicator has changed in a positive direction. Patients who were cured in 2012 and 2013 were about 46.0%. However, by 2022 this figure increased to 80.6%. However, there were less downturns between 2019 and 2020 (table 2).

There are cases when the patient's condition remains unchanged. This indicator varied between 3.2% and 6.7%. However, in 2014, 2017, 2019, the rate was above average and amounted to 7.7%, 15.6% and 10.0%, respectively (table 2). Deterioration was identified in few cases in 2013 – 1.6% as well as in 2017 – 0.4%.
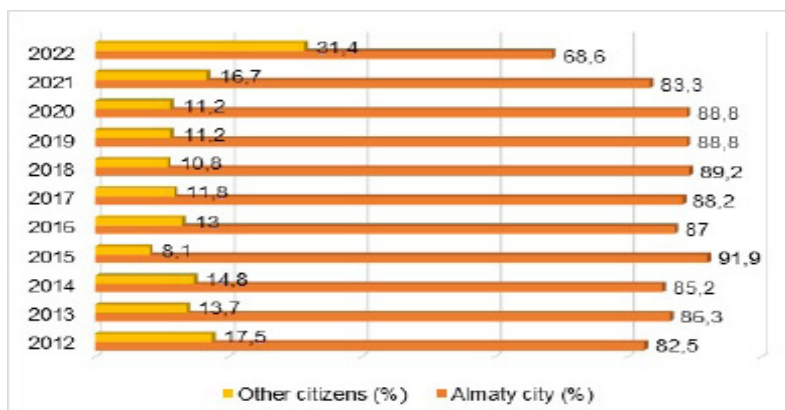

Figure 2 - Hospitalization of residents of Almaty and non-residents

Since the city of Almaty is a metropolis where medical organizations of the republican level are located, patients from other cities are accordingly observed. Thus, in dynamics we see that compared to 2012, the number of nonresident patients decreased from 31.4% to 17.5%, where the peak of the decrease was 8.1% in 2015. This decrease is associated with the development of high-tech services and stroke care programs in the country, within the framework of which regional-level hospitals began to introduce the latest treatment methods and technologies.

Discussion

Assessing and monitoring the country's socio-demographic indicators is a necessary procedure when planning medical expenses for the quality provision of planned and emergency care for acute cerebrovascular accidents. Overall, the studies show that average hospital stays were about 10 days, which is consistent with our data. It is also noted that women have a lower number of days compared to men [10,11]. Stroke can affect people of any age, although it has traditionally been perceived as a disease of older people, with incidence doubling every ten years after age 55 [12]. In recent years, the average age of stroke patients has been decreasing, and the incidence of strokes and hospitalizations among young people has been increasing worldwide [13,14]. Octavian Păun co-authors note that most often stroke occurs in people over 50 years of age. Our study also found that patients were hospitalized at this age [15].

Mortality rates were high in 2020, most likely due to the COVID-19. Research confirms the negative impact of COVID-19 on the condition of patients with stroke and cerebrovascular diseases, which are a risk factor for the deterioration of the health [16,17,18].

The idea of risk factors today is scientifically substantiated and is based on assessing the likelihood of developing acute cerebrovascular accidents depending on clinical, biochemical and many other characteristics, including the environment. It was found that often the first symptoms of a stroke, headache, are often overlooked, and therefore there is a risk of emergency hospitalization. In our study, the proportion of emergency hospitalization is still higher than planned; accordingly, measures are required to improve the knowledge of medical specialists on the symptoms of this nosology, for timely detection and diagnosis, and therefore the provision of assistance [19]. In a study of two million adults discharged from the emergency department with a primary diagnosis of headache, 0.5% were hospitalized for a major neurological disorder such as cerebral infarction (18%) and transient ischemic attack (12%) [20].

Secondary complications after intracerebral hemorrhage (ICH) can worsen outcome and are associated with early death. Of 10,029 patients with spontaneous intracerebral hemorrhage, the cumulative incidence of secondary complications was 39.9% of which were pneumonia (15.1%), cerebral edema (6.5%), cardiac decompensation (5.9%), urogenital infection (5.5%), hydrocephalus (4.6%), epilepsy (3.4%) and rebleeding (3.4%) [21]. In the future, it is necessary to study the frequency of complications that possibly lead to deterioration of the condition; in particular, for our study, the years where the rate of deterioration was the highest would be relevant.

Conclusion

Prevention and treatment still need to be continually improved, taking into account age, gender, risk factors and other factors. The introduction of stroke programs, as well as improvements in primary health care, have allowed us to improve care for patients with acute cerebrovascular accidents, but targeted strategies must be gradually developed in the future.

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Жедел цереброваскулярлық бұзылулармен байланысты ауруханаға жатқызылған жағдайларды зерттеу

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Түйіндеме

Церебральды инсультпен ауыратын науқастарға медициналық көмек көрсету жүйесін дұрыс ұйымдастыру өлімді азайтуға және мүгедектік деңгейін төмендетуге мүмкіндік береді. Барлық іс - шаралар диагностикалық тәсілдердің бірыңғай қағидаттарын құруға және инсультпен ауыратын науқастарды басқаруға бағытталған. Инсультпен ауыратын науқастарға медициналық көмек көрсету жүйесін оңтайландыру арқылы алғашқы профилактикаға маңызды рөл беріледі. Цереброваскулярлық патология және инсульт бойынша үйлестіру орталықтары құрылуда.

Біздің зерттеуіміздің мақсаты 2012-2022 жылдар аралығында Алматы қаласында ми қан айналымы жіті бұзылған пациенттерді емдеуге жатқызу жағдайларын талдау болып табылады.

Әдістері. Ретроспективті зерттеу жүргізілді. Деректерді талдау кезеңі 2012 жылдан 2022 жылға дейін болды. Талдау деректері пациенттердің жасын, төсекте өткізген күндерін, аурудың нәтижесін, шұғыл немесе жоспарлы ауруханаға жатқызуды қамтыды. Деректерді талдау SPSS 13 бағдарламасы арқылы жүргізілді.

Нәтижелер. Жедел цереброваскулярлық бұзылулары бар науқастардың жасы 10 жыл ішінде 59,8 диапазонында өзгерді, ал төсек күндері 11,46 болды. Шұғыл ауруханаға жатқызу жоспарланғанмен салыстырғанда жоғары болды, бірақ соңғы бес жылда бұл оң динамика болды. Сонымен қатар, 2012 жылдан бастап өлім-жітім деңгейі төмендеді, ал қалпына келтіру өсті, бұл жақсы нәтижелер мен медициналық мекемелерге қабылдауды білдіреді.

Қорытынды. Инсультті емдеу бағдарламаларын енгізу, сондай - ақ алғашқы медициналық - санитарлық көмекті жақсарту пациенттерге күтім көрсетуді жақсартуға мүмкіндік берді. Алдын алу және емдеу бағдарламалары әлі де жасына, жынысына, қауіп факторларына және басқа факторларға байланысты үнемі жетілдіруді қажет етеді.

Түйін сөздер: ми қан айналымының жіті бұзылуы, инсульт, ауруханаға жатқызу, төсек - күндер, Қазақстан.

Изучение госпитализированных случаев, связанных с острыми нарушениями мозгового кровообращения

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Резюме

Правильная организация системы оказания медицинской помощи пациентам с церебральным инсультом позволит снизить смертность и снизить уровень инвалидности. Все мероприятия направлены на создание единых принципов диагностических подходов и ведения пациентов с инсультом. Значительная роль отводится первичной профилактике путем оптимизации системы оказания медицинской помощи пациентам, перенесшим инсульт. Создаются координационные центры по цереброваскулярной патологии и инсульту.

Целью нашего исследования является анализ случаев госпитализации пациентов с острыми нарушениями мозгового кровообращения в период с 2012 по 2022 год в городе Алматы.

Методы. Было проведено ретроспективное исследование. Период анализа данных составлял с 2012 по 2022 год. Данные анализа включали возраст пациентов, дни, проведенные в постели, исход заболевания, экстренную или плановую госпитализацию.

Результаты. Возраст пациентов с острыми нарушениями мозгового кровообращения колебался в течение 10 лет в диапазоне 59,8, а количество койко-дней составило 11,46. Количество экстренных госпитализаций было выше по сравнению с запланированными, однако за последние пять лет это была положительная динамика. Кроме того, с 2012 года уровень смертности снизился, в то время как выздоровление увеличилось, что означает лучшие результаты и прием в медицинские учреждения.

Выводы. Внедрение программ по борьбе с инсультом, а также улучшения в первичной медико-санитарной помощи позволили нам улучшить уход за пациентами. В то время как программы профилактики и лечения по-прежнему нуждаются в постоянном совершенствовании с учетом возраста, пола, факторов риска и других факторов.

Ключевые слова: острые нарушения мозгового кровообращения, инсульт, госпитализация, койко-дни, Казахстан.

Review article

Cognitive impairment as a medical and social problem: Risk factors and prevention

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Abstract
Aging is accompanied by cognitive decline, which can lead to dementia. The prevalence of dementia is projected to increase in the next decade due to increased life expectancy.

A literature search was conducted to identify studies on cognitive impairment as a medical and social problem, prevention, and risk factors published from 2013 to 2023 (10 years). The online databases PubMed, Google Scholar, Scopus, and Web of science were used to search the literature.

Mental health problems are underestimated by health professionals and the elderly themselves, and the malady associated with this problem makes people reluctant to seek help.

Clinically, cognitive impairment can cause serious social, occupational impairment. Lifestyle and cognitive therapy can improve memory at least as well as drug therapy. Many researchers have studied risk factors for cognitive impairment. Among them, the main ones are age, cholesterol, high blood pressure, obesity, depression, education, nutrition, sleep, mental state, physical and social activity. Comprehensive screening of clinical, cognitive and functional areas of fitness is mandatory for older people in order to eliminate modifiable risk factors through specially designed rehabilitation programs. Cognitive impairment is one of the important medical and social problems in modern society, as it is a condition preceding dementia. The observed aging of the world population contributes to the risk of an increase in the prevalence of cognitive impairment.

Keywords: cognitive impairment, prevention, risk factors.

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Introduction

By 2050, the World Health Organization (WHO) estimates that there will be 2 billion people over the age of 60 in the world [1]. Particularly rapid population aging is occurring in low- and middle-income countries. Persons of elderly and senile age can be easily attributed to the risk group for the occurrence of mental disorders. This is due both to the physiological processes occurring in the body from a certain age, and to psychological and social factors. Aging is accompanied by cognitive decline, which can lead to dementia. The prevalence of dementia is projected to increase in the next decade due to increased life expectancy.

The main consequences of cognitive impairment in the elderly include impaired quality of life, loss of social functions, and eventually dependence on home care or hospitalization, which entails huge financial resources from the public health system [2].

A literature search was conducted to identify studies on cognitive impairment as a medical and social problem, prevention, and risk factors published from 2013 to 2023 (10 years).

Literature Search Strategy

A literature search was conducted to identify studies on cognitive impairment as a medical and social problem, prevention, and risk factors published from 2013 to 2023 (10 years). The online databases PubMed, Google Scholar, Scopus, and Web of science were used to search the literature. Only peer-reviewed articles in English that mentioned "prevention, risk factors for cognitive impairment" were taken into account. Study selection process is presented in Figure 1.
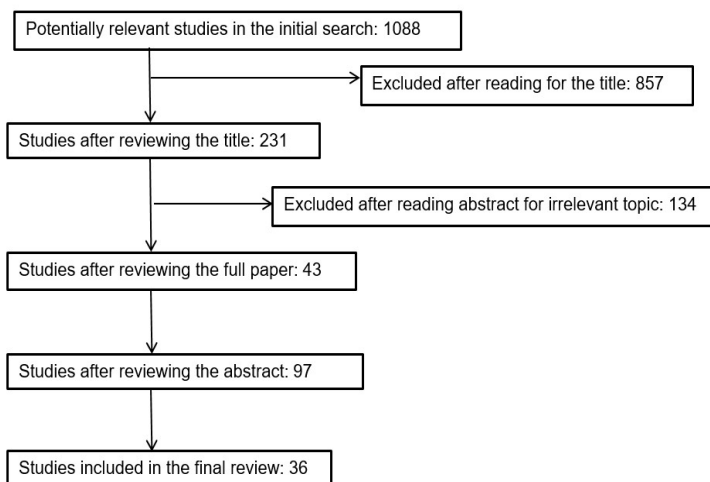

Figure 1 - Study selection process flow chart

Cognitive impairment as a medical and social problem

The global prevalence of dementia is 1.2-7.2% [3], and the population of older people with dementia is expected to increase in line with global aging. The reported proportion of people with mild cognitive impairment (MCI) is 5.0% - 36.7% higher than the proportion of people with dementia; however, most cases of MCI and dementia in the elderly often remain undiagnosed and unrecognized [4]. The number of people over 65 years of age is increasing everywhere [5]. All over the world, the population is rapidly aging. Between 2015 and 2050, the proportion of the world's population over 60 is expected to nearly double, from 12% to 22%. Mental and neurological disorders in the elderly account for 6.6% of total disability for this age group. Approximately 15% of people aged 60 years and older suffer from mental disorders [6].

Dementia is a syndrome, usually chronic or progressive, in which there is deterioration in memory, thinking, behavior, and the ability to carry out daily activities. It mainly affects the elderly, although it is not a normal part of aging. An estimated 50 million people worldwide are living with dementia, almost 60% living in low- and middle-income countries. The number of people with dementia is projected to reach 82 million in 2030 and 152 million in 2050 [7]. Today there are serious social and economic problems associated with the direct costs of medical, social and informal care related to dementia. In addition, the physical, emotional and economic pressures can cause great stress for families and caregivers of people with dementia. Therefore, there is a need for support from the health system of the social, financial and legal systems for both people with dementia and those who care for them [8]. Health services deal with a large number of elderly patients. Although the vast majority of elderly people have fairly good health and lead an active lifestyle, a significant number of them are at risk of developing various chronic conditions and mental disorders, including dementia. It is estimated that 46.8 million people worldwide suffer from dementia, which causes a serious burden on medical, social and informal care [9]. One of the clinical conditions preceding dementia is cognitive impairment (CI). In fact, one-third of CI patients are thought to develop dementia. Thus, early detection of CI may provide several benefits, including early diagnosis of dementia and access to treatment, delay or even reversal of CI [10]. The United Nations (UN) has not yet proposed a clear criterion for defining old age, but as a general rule, people aged 60 and over are classified as older people.

Although some degree of memory weakness is normal in older age, the term "dementia" is also used to refer to memory decline and forgetfulness among this age group. Since the symptoms appear gradually, they may not attract attention for a long time, and thus, it can be misinterpreted that such behavior is part of the aging process. It is noted that the prevalence of CI exceeds 40% among the elderly [11]. On the other hand, the existing term "mild cognitive impairment" describes the course of a neurodegenerative disease in which cognitive functions are not normal compared to age expectations, but daily functions are not impaired to qualify for a diagnosis of dementia [12].

Individuals with MCI have subjective cognitive complaints that are usually corroborated by an informant, preserved general cognitive functioning, impairment in one or more cognitive areas (memory, attention-executive function, visuospatial skills, and/or language), and essentially lead normal daily activity. MCI remains a clinical diagnosis, aided by a thorough history, neurologic examination, mental status screening, and formal neuropsychological testing [13]. MCI is not synonymous with Alzheimer's disease (AD) and does not always lead to dementia. Universal screening for certain age groups would be ideal, but is currently limited due to a lack of established guidelines, ignorance of clinicians, and time and cost constraints. There are currently no pharmacological treatments that have proven to slow or treat the progression of MCI to dementia; however, there is evidence that lifestyle modifications, including diet, exercise, and cognitive stimulation, can be effective [14].

Along with physicians, nurses play an important role in the diagnosis and post - diagnosis periods for patients with early CI. Older people living in rural areas are often left behind, while their stories can provide information to help nurses better provide early interventions to improve cognitive health [15]. Primary health care (PHC) should be the place for early detection of MCI and dementia; however, a significant part of these processes still remains unattended. Family physicians may not have enough time or experience for cognitive testing. Caring for a patient with cognitive and neuropsychiatric disorders is a certain stress, and caregivers of patients with dementia subsequently experience severe psychological stress, reduced life satisfaction and progression of depression. This means that dementia is not only a neurological disease, but also a serious public health problem [6].

MCI is an intermediate stage on the trajectory from normal cognitive health to dementia. Patients with MCI have a high rate of dementia progression over a relatively short period [16-18]. Even among people who return to normal cognitive activity at some point in time, the incidence of subsequent MCI or dementia is higher than among those who have never suffered from MCI. In addition to MCI, the other two classifications include cognitive impairment without dementia, which covers a wider range of cognitive impairment, and MCI due to AD, primarily identifying people with AD [19].

Mental health problems are underestimated by health professionals and the elderly themselves, and the malady associated with this problem makes people reluctant to seek help [7]. Clinically, cognitive impairment can cause serious social, occupational impairment [20].

Prevention of cognitive impairment in the elderly

One possibility of increasing the average age in the population and preventing cognitive impairment is the optimal diet. Of the various dietary components, vitamins B9 and B12 are thought to contribute to the optimal course of aging [12]. Morimoto S.S. et al. have developed some types of computerized cognitive remediation (CCR) based on neuroplasticity that target the brain regions responsible for executive functioning, and preliminary studies are encouraging [20].

A japanese study compared the effects of a combination of soy peptide supplementation and exercise on cognitive function in older adults. The randomized, unblinded, controlled clinical trial involved 67 participants aged 60 years or more with non-cognitive dysfunction, who were divided into two groups according to the intervention method: the exercise group (Ex group, n=36) and the exercise plus nutrition group (Ex group) + Nt, n=31). The Ex group performed a memory exercise for 15 minutes and an aerobic exercise for 45 minutes once a week for 90 days. The Ex + Nt group completed the same workout plus received soy peptide for 90 days. Mini-Mental Status Score, Track Making Test A/B Score, Skeletal Muscle Mass Index, Grip Strength, Gait Speed, and Geriatric Depression Scale were measured at baseline and after the intervention. A two-way analysis of variance was performed to compare between pre - and post-measurements to determine intervention effects. The significance level was set at < 5%. A combination of exercise and soy peptide supplementation was effective in improving some of the cognitive performance [21, 22].

Since there is currently no effective pharmacological treatment for subjective cognitive decline and MCI, modifiable risk factors for cognitive decline and dementia have received increased attention in the literature as a focus for clinical trials. Physical activity is one of the strongest protective lifestyle factors. In the future, research is needed to help provide specific recommendations for exercise intensity, effective strategies to promote behavior change [23, 24]. In the absence of treatment options, WHO emphasizes that effective prevention strategies are key to countering the dementia epidemic. Considering the complex nature of dementia, trials that simultaneously target multiple risk factors should be particularly effective for prevention. However, only a few such multicomponent trials have been launched so far, and they have shown promising results [25].

Cognitive decline and dementia are serious threats to the independence and quality of life of older people. Therefore, identifying interventions that help maintain cognitive function in older adults or reduce the risk of dementia is a research priority. Cognitive training uses the repetitive practice of standard exercises that target one or more cognitive areas and is designed to maintain optimal cognitive function. There is evidence that computer-assisted cognitive training for at least 12 weeks has a beneficial effect on cognitive function in healthy adults aged 65 and over [26].

The mental health of the elderly is enhanced by active and healthy aging, including conditions that allow them to lead a healthy lifestyle. The prerequisites for meeting their needs are:

- safety and freedom;

- supportive housing policy;

- social support;

- medical and social programs intended for persons suffering from chronic or recurrent mental illnesses;

- elder abuse prevention programs.

Equally important is long-term care for older people with mental health conditions [7].

Risk factors for the development of cognitive impairment

Multiple mental health risk factors are allowed at any point in life. Older people experience not only the stresses of life that are common to all people, but also the stresses that occur later in life, such as significant permanent loss and decline in functional abilities. For example, older people may experience decreased mobility, chronic pain, weakness, or other health problems for which they require long-term care. All of these stresses can lead to isolation, loneliness or psychological distress for them [7]. Factors such as cholesterol levels, high blood pressure, obesity, depression, education, diet, sleep, mental health, and physical and social activity also play a role [11].

In a study conducted in Ecuador, the prevalence of CI was higher with age > 65 years and low level of education. Significant risk factors such as hypertension, diabetes mellitus and illiteracy, which are the most common, were identified [10].

Another risk factor for dementia is smoking, which, together with vascular changes caused by atherosclerosis, can account for almost 40% of all cases of dementia [12]. It has been shown that the decline in cognitive health is probably inextricably linked to many aspects of general health, namely, cardiological status, mental health (depression), chronic pain and mobility, at least among the elderly. When these problems are present, social functioning can also suffer [29]. Subjective cognitive decline (SCD) is common in older adults and may be an early marker of future cognitive decline. Studies by spanish, australian, brazilian and american scientists show that SCD is more closely associated with concomitant symptoms of depression than with objective cognitive characteristics in non-hispanic whites, but it is unknown whether the associations of SCD, cognitive functions and depression are manifested differently in Spanish - speaking elderly people [30,31]. The prevalence of MCI in adults aged ≥65 years is 10–20%; the risk increases with age, and men are at higher risk than women. International studies indicate the impact of gender differences on cognitive functioning [32]. In older patients with MCI, clinicians should consider depression, polypharmacy,

and uncontrolled cardiovascular disease risk factors that may increase the risk of CI and other adverse outcomes [33].

International studies show the impact of gender differences on cognitive functioning. It was found that the number of cases of moderate cognitive impairment per year in men was higher than in women. Men, on the other hand, had a higher incidence of mild cognitive impairment. An important difference between women and men was a significantly higher representation of depression. Women are at greater risk of developing dementia associated with Alzheimer's disease, while men are at greater risk of developing vascular dementia [34]. Thyroid hormones have been reported to be associated with cognitive decline and AD. An association has been shown between thyroid function and cerebral blood flow in patients with AD. The present study showed the association of thyroid-stimulating hormone with regional cerebral blood flow in the group of individuals with MCI and the association of free triiodothyronine with regional cerebral blood flow in the group of individuals with AD [35].

The available data suggest that a significant proportion of cases of age-related cognitive decline and dementia can be prevented by changing risk factors, including education, depressive symptomatology, physical activity, social activity and participation in cognitive-stimulating activities.

Many researchers have studied risk factors for cognitive impairment [12,17,18]. Among them, the main ones are age, cholesterol, high blood pressure, obesity, depression, education, nutrition, sleep, mental state, physical and social activity. They show that cognitive impairment is inextricably linked with many aspects of general health. Carers often focus only on the physical needs of the patient. Social interaction or hobbies are often neglected, which is a major problem. Therefore, a comprehensive screening of clinical, cognitive and functional areas of fitness is mandatory for older people in order to eliminate modifiable risk factors through specially designed rehabilitation programs.

In order to maintain autonomy and social participation, it is recommended that the elderly themselves perform their daily activities. Daily activity is recognized as one of the most effective factors in maintaining the health and success of the elderly [11]. Cognitive memory training, in turn, may improve memory function in older people with MCI, as it is assumed that brain plasticity is preserved in them [27,28].

The available data confirm that lifestyle and cognitive therapy can improve memory at least as well as drug therapy. A number of researchers believe that daily activity is recognized as one of the effective factors for maintaining health and success by the elderly.

Conclusions

Thus, cognitive impairment is one of the important medical and social problems in modern society, as it is a condition preceding dementia. The observed aging of the world population contributes to the risk of an increase in the prevalence of cognitive impairment. Therefore, PHC should be a place for early detection of MCI and prevention of dementia. Thus,

timely detection and adequate treatment of cognitive impairment can improve the quality of life of patients, their close relatives and caregivers.

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**Когнитивті бұзылулар медициналық-әлеуметтік проблема ретінде:
Қауіп-қатер факторлары және алдын алу**

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Түйіндеме

Қартаю когнитивті қабілеттің төмендеуімен бірге жүреді, бұл деменцияға әкелуі мүмкін. Деменцияның таралуы өмір сүру ұзақтығының артуына байланысты келесі онжылдықта артады деп болжануда.

Онжылдық, яғни 2013-2023 жылдар аралығында жарияланған когнитивті бұзылулар медициналық және әлеуметтік проблема ретінде, алдын алу және қауіп-қатер факторлары туралы зерттеулерді анықтау үшін әдебиеттерді іздеу жүргізілді. Әдебиеттерді іздеу үшін PubMed, Google Scholar, Scopus және web of science онлайн дереккорлары пайдаланылды.

Психикалық денсаулық мәселелерін Денсаулық сақтау мамандары мен қарттардың өздері бағаламайды және бұл мәселеге байланысты ауру адамдарды көмек сұрауға құлықсыз етеді.

Клиникалық когнитивті бұзылулар ауыр әлеуметтік және кәсіби бұзылуларды тудыруы мүмкін. Өмір сүру салты мен когнитивті терапия, кем дегенде, дәрілік терапия сияқты есте сақтау қабілетін жақсарта алады. Көптеген зерттеушілер когнитивті бұзылулардың қауіп-қатер факторларын зерттеді. Олардың ішінде жас, холестерин деңгейі, жоғары қан қысымы, семіздік, депрессия, білім, тамақтану, ұйқы, психикалық күй, физикалық және әлеуметтік белсенділік негізгі болып табылады. Арнайы әзірленген оңалту бағдарламалары арқылы өзгертілетін қауіп-қатер факторларын жою мақсатында егде жастағы адамдар үшін клиникалық, когнитивті және функционалдық дене шынықтыру саласының жан-жақты скринингі міндетті болып табылады. Когнитивті бұзылулар қазіргі қоғамдағы маңызды медициналық және әлеуметтік мәселелердің бірі болып табылады, өйткені бұл деменцияға дейінгі жағдай. Жер шарындағы халықтың қартаюы когнитивті бұзылулардың таралу қаупін арттырады.

Түйін сөздер: когнитивті бұзылыс, алдын алу, қауіп факторлары.

**Когнитивные нарушения как медико-социальная проблема:
Факторы риска и профилактика**

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Абстракт

Старение сопровождается снижением когнитивных способностей, что может привести к деменции. По прогнозам, распространенность деменции увеличится в следующем десятилетии в связи с увеличением продолжительности жизни.

Был проведен поиск литературы для выявления исследований когнитивных нарушений как медицинской и социальной проблемы, профилактики и факторов риска, опубликованных в период с 2013 по 2023 год (10 лет). Для поиска литературы использовались онлайн - базы данных PubMed, Google Scholar, Scopus и Web of science.

Проблемы психического здоровья недооцениваются медицинскими работниками и самими пожилыми людьми, и заболевание, связанное с этой проблемой, заставляет людей неохотно обращаться за помощью.

Клинически когнитивные нарушения могут вызывать серьезные социальные и профессиональные нарушения. Образ жизни и когнитивная терапия могут улучшить память, по крайней мере, так же, как медикаментозная терапия. Многие исследователи изучали факторы риска когнитивных нарушений. Среди них основными являются возраст, уровень холестерина, высокое кровяное давление, ожирение, депрессия, образование, питание, сон, психическое состояние, физическая и социальная активность. Всесторонний скрининг клинической, когнитивной и функциональной сферы физической подготовки является обязательным для пожилых людей с целью устранения модифицируемых факторов риска с помощью специально разработанных программ реабилитации. Когнитивные нарушения являются одной из важных медицинских и социальных проблем в современном обществе, поскольку это состояние, предшествующее деменции. Наблюдаемое старение населения земного шара повышает риск увеличения распространенности когнитивных нарушений.

Ключевые слова: когнитивное нарушение, профилактика, факторы риска.

Original article

Hygienic assessment of the nature of the labor processes of miners engaged in underground mining polymetallic ore

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Abstract

Working conditions at mining enterprises are determined by the technology of the production process. Modern working conditions for workers are characterized by high dust levels, intense noise and vibration, unfavorable microclimate, a high degree of psycho-emotional stress and heavy physical labor.

Purpose: Hygienic assessment of the degree of severity and intensity of the nature of work of miners in underground mining of polymetallic ores, taking into account the performance of various technological operations to predict the risk of health problems and optimize labor.

Methods. The object of the study were miners of underground ore mining at the Zhezkent mining and processing plant of Kazakhmys Corporation LLP in the East Kazakhstan region. Comprehensive hygienic studies were carried out to assess the degree of severity and intensity of labor processes of miners in underground ore mining, taking into account the performance of technological operations.

Results. The results of a hygienic assessment of full-shift time-lapse studies of the nature of the work of miners of various professional groups made it possible to establish that operators of underground mining equipment spent more than 44.2% of their shift time on the main operations of drilling and extracting ore, 38.5% on auxiliary operations, final operations – 5.6%. Miners engaged in fastening the face space, repair work, loading ore onto scraper winches, etc. spent half (54.3%) of their shift time on main operations, about 25.3% on auxiliary work, and 9.5% of their shift time was spent on final works.

Conclusions. Thus, the results of timing studies made it possible to establish that:

The labor activity of miners in operating mining equipment corresponded to class 3.3 in terms of intensity of labor processes, and class 3.2 in terms of severity. The work of fasteners, drifters and longwall miners, whose technological operations are associated with the performance of non-mechanized types of labor operations, required significant physical effort and corresponded to class 3.3 in terms of the severity of labor, and class 3.2 in terms of labor intensity.

Key words: nature of labor processes, miners, occupational health, occupational risk, mining industry.

Introduction

One of the key components of sustainable socio-economic development and high labor productivity in society is the health and well-being of working citizens. The recognition of the importance of human capital and its role in driving sustainable growth and innovation across systems has led to the pursuit of new avenues for improving the collaborative efforts of all stakeholders: the healthcare system, the state, society, and employers [1,2].

The work of miners in modern underground ore mines is characterized by the use of a wide range of high-performance machines and mechanisms, which introduce new requirements for labor processes [3,4]. Underground ore mining involves a series of operations to provide access from the surface to ore deposits, including contouring the ore body, creating tunnels, extracting ore, and constructing track systems. Horizontal and inclined mining tunnels are often developed using drilling and blasting methods, where workers sequentially perform tasks such as drilling and loading blast holes, conducting explosive work, clearing debris, loading and transporting blasted material, securing tunnels, and extending tracks, pipelines, and other communications. Various types of electric drills are used during drilling, and blast hole loading is done manually. The removal of blasted material is handled by rock-loading machines. The remaining tasks in the mining cycle - such as securing the tunnel face, laying tracks, and extending communications - are performed manually. The most arduous aspects of this work are the extended walking over long distances, often in inclined tunnels, and the clearing of rock masses.

The working conditions in underground mining are particularly strenuous and demanding, where exposure to high concentrations of dust, vibration, noise, and an unfavorable microclimate is exacerbated by psycho-emotional stress. The constant lack of sunlight, the confined spaces during work operations (which often require uncomfortable postures), and the presence of explosive gases create conditions conducive to health deterioration and the risk of developing occupational diseases [5-7].

It is also important to emphasize that the presence of harmful factors in the working environment (dust, noise, vibration, heat, and low lighting) not only complicates the functional interaction within the "human-work environment" system but also serves as an excessive irritant that poses potential dangers to almost all major functional systems of the body, ultimately leading to an increased risk of occupational diseases [8-10].

According to the classification of mining work by the degree of severity and required rest time, the severity of the tasks performed ranges from light to heavy and very heavy work. Operating machinery does not require significant physiological effort from miners, and preparatory operations are also considered light work. However, performing auxiliary, mostly non-mechanized tasks (such as shoveling, pulling power cables, securing roofs for safety, etc.) leads to significant shifts in the functional state of miners' bodies. The risks of disease are heightened by the cooling microclimate of workplaces, general and localized vibration, noise, dust and gas mixtures, physical overexertion, work in forced and uncomfortable postures, as well as other factors related to the work environment and labor processes.

The most common pathologies that arise during miners' work activities include musculoskeletal and nervous system disorders, vibration disease, neurosensory hearing loss, and respiratory diseases. These health issues are the primary causes of premature reduction or complete loss of professional work capacity among miners [11-14].

The combination of industrial factors in the performance of key technological operations in underground mining determines a high degree of occupational health risk for workers and leads to the development of occupational diseases. Therefore, it is crucial to investigate the cause-and-effect relationship between occupational factors and the health of miners employed in the mining industry from the perspective of occupational risks.

Materials and Methods

The study focused on underground miners at the Zhezkent Mining and Processing Plant, which is part of the Kazakhmys Corporation in the East Kazakhstan region. The underground miners involved in polymetallic ore extraction were divided into two groups: the main group, which included drill rig operators, load-haul-dump machine operators, and scraper operators; and the auxiliary group, which included miners, stope builders, blasters, and underground electrician-mechanics.

To measure the maximum grip strength, a portable dynamometer (DRP-90) was used. For assessing the static endurance of hand muscles, the maximum muscle strength was first determined, after which the subject was instructed to maintain 2/3 of the maximum effort until they could no longer continue the static task. The duration of this effort, recorded in seconds, was used as an indicator of static endurance. Handgrip strength was measured using a stand dynamometer (DS-500).

Functional changes in the cardiovascular system were assessed by central hemodynamic indicators: systolic and diastolic blood pressure (SBP and DBP) were measured using the N.S. Korotkov method, and heart rate (HR) was calculated using a stopwatch by counting the pulse [15].

To evaluate respiratory function, the respiratory rate (RR) and minute ventilation (MV) were recorded using a volumeter, and the maximum voluntary ventilation (MVV) and breathing reserve (BR) were determined.

Comprehensive hygienic studies to assess the nature of the labor processes of the main and auxiliary occupational groups of underground miners were conducted in accordance with the Methodological Recommendations "Hygienic Criteria for Assessing and Classifying Working Conditions Based on the Harmfulness and Hazard of Factors in the Working Environment, and the Severity and Intensity of the Labor Process," approved by the Committee for Sanitary and Epidemiological Control of the Ministry of Health of the Republic of Kazakhstan on December 31, 2020, No. 24 [16].

This work was carried out as part of an initiative research project on the topic: "Predicting Health Disorders in Workers Engaged in the Extraction and Processing of Polymetallic Ores from the Perspective of Occupational Risks" (state registration number 0123RK I 0358 dated September 27, 2023).

Results. Underground polymetallic ore mining at the Zhezkent Mining and Processing Plant is conducted at depths ranging from 800 to 1300 meters. The results of full-shift time-motion studies of the work activities of machine operators involved in underground polymetallic ore mining revealed that during an 8-hour work shift, the preparatory phase included checking mechanical, electrical components, pneumatic systems, and lighting installations. On average, these operations took 17 minutes of the work shift time (Table 1).

Table 1 - Timekeeping of working day of mining machinery control operators at Zhezkent Mining and Processing Plant, (M±m)

Labour operations	Working time costs	
	minutes	percentage
Shift acceptance	17±7	3,5
Preparatory stage: preventive inspection of machinery, replacement of parts, cleaning of nozzles, checking of mechanical, electrical, hydraulic parts, pneumatic systems and lighting systems	27±12	5,6
Main stage: control of mining equipment, drill heads, drilling and own drilling.	212±9	44,2
Auxiliary operations: clearing the ground at the mining equipment, preparation for work	185±12	38,5
Breaks	21±5	4,38
Shift handover	18±6	3,75
Total	480	100

The main stage of the work involved positioning the drill heads at the face of the work area, initiating drilling, and the actual drilling process. During this phase, the driller monitors the water, air, and oil pressure. The primary work area during drilling is the platform at the control panel. The design of the drill booms ensures automatic maintenance of parallelism of the auto-feeders. The feed force of the jackhammer during drilling reaches no less than 1,000 kgf.

The hydraulic system of the drilling rigs is powered by hydraulic pumps driven by electric motors.

The drilling rigs are equipped with both working and parking brakes, ensuring effective braking during movement and at rest. Using levers, the driller performs operations such as raising, lowering, and rotating the boom, as well as directing the boom to the face of the work area. The driller then activates the water supply system, the rotary drive, and the striker for drilling and borehole creation to the required depth. The duration of the main stage ranges from 2.2 to 4.0 hours. On average, this stage consumes 44.2% of the shift time.

Table 2 - Timekeeping of the working day of underground miners engaged in manual labour at Zhezkent Mining and Processing Plant, (M±m)

Labour operations	Working time costs	
	minutes	percentage
Preparation of explosives and bonding materials, bringing up the drive, tightening clamps, clearing the ground near mining machines and between frames, loading boreholes with explosives, loading dry mortar manually from the dump truck body into the torquet gun, etc.	120,9 ±12,0	25,2
Scraping and levelling the roof of the formation, crushing large pieces, throwing rock mass on the scraper track, loading rock mass on conveyor belts, fixing the roof with reinforcing bars or reinforced concrete rods, torqueting, etc.	260,5 ±18,2	54,3
Cleaning of the service area, minor repairs of mechanical parts of machinery and equipment	45,5±5,3	9,5
Total	480	100

Auxiliary operations, including clearing the ground at the face of the work area, breaking up rock mass, preparing for loading operations, and transporting the rock mass, account for 38.5% of the shift time.

The final stage: 18 minutes before the end of the work shift, the miners operating the drilling equipment blow out the boreholes, disconnect the water and air hoses, bring the drill carriage to the transport position, and move it to the main parking area.

For clearing the face and loading the rock mass, load-haul-dump machines of types TOR-300 and R-1300 from CATERPILLAR are used. These machines are operated with either electric or pneumatic drives. They have a load capacity of over 5 tons or are powered by a diesel engine with up to 147.2 kW of power. During a shift, the machine dumps 40 buckets onto the loading machines over a distance of up to 10 meters.

For transporting the rock mass to scraper shelves, EJC-417 dump trucks from TAMROK are used. The rock mass is unloaded from the scraper shelf using LS-55 scraper winches into VB-4.5 wagons, which are then transported using electric locomotives.

To extract ore from the chambers, the excavated space is filled with a hardening mixture. The inclined drift is reinforced with yielding arch supports SVP-27, followed by backfilling with concrete, steel rods, and a combination of supports (concrete + chain-link mesh + shotcrete).

The ventilation-backfill layer is expanded by constructing a log crib, followed by the laying of the upper layer. Ore from the last stopes is transferred to the haulage level via the ventilation-rise drift. The backfill mixture is delivered to the clearing operations through a pipeline located in the ventilation-backfill block and cut paths.

Table 3 - Labour severity assessment of mining workers in underground mining of polymetallic ores at Zhezkent Mining and Processing Plant

Labour severity indicators	Drill rig typist	Typist of scraper winches	Typist of loading and unloading equipment	Fixer	Sinker	Mining labourer of the mine face
1. Physical dynamic load (kg m) 1.1 regional load: moving a load up to 1m	2	2	1	3.1	3.1	3.1
1.2 general load: load displacement from 1 to 5 m	1	1	1	3.2	3.1	3.1
2. Weight of lifted and moved load (kg) 2.1 when alternating with other work	2	2	3.1	3.2	3.1	2
2.2 continuously during the shift	2	2	2	3.2	3.1	3.1
2.3 total weight for each hour of the shift	2	2	3.1	3.1	3.1	3.1
3. Stereotyped work movements 3.1 local	3.1	3.1	2	3.1	2	1
3.2 regional load	3.1	2	3.1	3.1	2	2
4. Static load (kgf s) 4.1 with one hand	2	2	2	3.1	2	3.1
4.2 with two hands	2	2	2	3.2	3.1	3.1
4.3 involving the muscles of the body, legs	2	2	3.1	3.2	3.1	3.2
5. Working posture	3.1	3.1	3.1	3.2	3.1	3.2
6. Body tilts (number per shift)	3.1	2	3.1	3.2	3.1	3.1
7. Movement in space (km) 7.1 horizontally	1	2	1	2	2	3.1
7.2 vertically	1	1	1	1	1	2
Severity class of working conditions	3.2	3.1	3.1	3.3	3.3	3.3

Underground miners, during the course of tunneling and extraction operations, engage in both professional and operational forms of labor division.

At the beginning of the shift, underground miners prepare explosives and binding materials, bring in the drive, tighten clamps, clear the ground near the mining machines, and between frames. On average, preparatory work consumes approximately 22.9 to 25% of the shift time (Table 2).

Table 4 - Assessment of the degree of tension of labour processes of mining workers of underground mining of polymetallic ores

Indicators of labour intensity	Drill rig typist	Typist of scraper winches	Typist of loading and unloading equipment	Fixer	Sinker	Mining labourer of the mine face
1 Intellectual workload Work content	3.1	3.2	3.2	2	2	2
Signal perception evaluation	3.1	3.2	3.2	3.1	2	2
Distribution of functions by degree of task complexity	3.1	3.2	3.2	3.1	3.1	3.1
Nature of work	3.2	3.2	3.2	3.1	3.1	3.1
2 Sensory loads Duration of concentrated observation	3.1	3.2	3.1	1	1	2
Signal density per 1 hour of work	2	3.1	3.1	1	1	3.1
Number of production objects of simultaneous observation	3.1	3.1	3.1	2	2	3.1
Load on auditory analyzer	3.2	3.2	3.1	1	1	1
Load on the vocal apparatus	3.2	3.2	3.2	1	1	1
3 Emotional loads Degree of responsibility for the result of own activity.	3.2	3.2	3.2	3.1	3.1	3.1
Degree of risk for own life	3.2	3.2	3.2	3.2	3.1	3.1
Degree of responsibility for the safety of others	3.2	3.2	3.2	3.2	3.1	3.1
4 Monotony of loads Number of elements to realise a simple task	3.1	3.1	3.1	2	2	2
Duration of fulfilment of simple production tasks	2	2	2	2	2	1
Active time	2	2	2	1	1	1
Monotony of the work environment	3.1	3.1	3.1	1	1	1
5 Work mode Actual working day duration	2	2	2	2	2	2
Shift work	3.1	3.1	3.1	3.1	3.1	3.1
Presence of a regulated break	2	2	2	1	1	1
Class of labour conditions in terms of tension	3.3	3.3	3.3	3.2	3.1	3.1

After the extraction and transportation of the rock mass, the workers reinforce the tunnels using hand tools. The primary task of the stope builders involves securing the roof with reinforcement bars, precast concrete rods, loading dry mix manually from the dump truck bed into the shotcrete gun, and shotcreting. Over the course of a shift, stope builders manually construct approximately 12 wooden frames, each weighing 7-8 kg, and install around 40 reinforced mesh panels, each weighing 30-40 kg.

The work of delivering support materials and installing the supports requires significant physical effort, particularly when lifting and installing temporary mechanical supports (weighing between 50 kg and 90 kg) or permanent support elements like heavy metal arches and precast concrete linings. The work of the stope builders involves significant postural strain on the muscles of the back and lower limbs. These primary tasks consume 47.9% of the shift's time budget.

Scraper winches of the LS-55 model are used in the work areas. The scraper winch is installed on scraper shelves in the winch chamber. The chamber is reinforced with non-combustible metal arch supports, the sides and roof are secured with mesh linings, and voids are filled with ore. On the scraper shelves, a ladder is installed on the haulage level, with the walking side protected by a continuous metal barrier. The width of the walking side from the edge of the chamber to the winch was 0.7 meters, with 0.6 meters on the other side for installation work. During a shift, the scraper operator loads between 3 to 10 wagons of ore. Scraping waste, cleaning and leveling the roof of the seam, breaking up large pieces, and shoveling the rock mass onto the scraper track require approximately 25% of the shift's time budget. The primary tasks account for 54.3% of the shift's time budget.

The analysis of the full-shift time-motion study results revealed that the heaviest work was carried out by stope builders, tunnelers, and miners in the stoping face, whose work primarily corresponded to Class 3.3 in terms of labor intensity (Table 3).

Labour activity of machinists on the control of drilling rig, scraper winches, loading and unloading equipment corresponded to the degree of tension class 3.3 (Table 4).

Discussion

The results of the hygienic assessment based on full-shift time-motion studies revealed that the work of operators managing mining equipment is largely associated with high neuro-emotional stress. This stress is primarily due to their high responsiveness to the effects of light, dust, and noise, quick decision-making in emergency situations, and the responsibility for the safety of their team.

For miners in key professions (stope builders, tunnelers, repair workers, and face miners), the work is characterized by excessive physical exertion, leading to early fatigue and significant strain on the neuromuscular and musculoskeletal systems [17,18.19].

Conclusions

The occupational activities of operators managing mining equipment corresponded to Class 3.3 in terms of the intensity of labor processes and to Classes 3.1 and 3.2 in terms of physical exertion. The work of stope builders, tunnelers, and face miners, whose technological operations involve non-mechanized tasks, required significant physical effort and was classified as Class 3.3 in terms of physical exertion and Classes 3.1 and 3.2 in terms of intensity.

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Жер асты полиметаллдық тау-кен өндірісімен айналысатын кеншілердің еңбек процестерінің сипатына гигиеналық баға беру қызметтері

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Түйіндеме

Тау-кен кәсіпорындарындағы еңбек жағдайлары өндіріс процесінің технологиясымен анықталады. Жұмысшылардың қазіргі жұмыс жағдайлары шаңның жоғарылауымен, қарқынды шу мен дірілмен, қолайсыз микроклиматпен, психоэмоционалды стресстің жоғары деңгейімен және ауыр физикалық еңбекпен сипатталады.

Зерттеудің мақсаты: денсаулық проблемаларының туындау қаупін болжау және еңбекті оңтайландыру үшін әртүрлі технологиялық операцияларды орындауды ескере отырып, полиметалл кендерін жерасты өндіру кезінде кеншілердің еңбек сипатының ауырлығы мен шиеленіс дәрежесін гигиеналық бағалау.

Әдістері. Зерттеу нысаны Шығыс Қазақстан облысындағы "Қазақмыс корпорациясы" ЖШС Жезкент тау-кен байыту комбинатының жерасты кен өндіру кеншілері болды. Технологиялық операциялардың орындалуын ескере отырып, жерасты кендерін өндіру кезінде кеншілердің еңбек процестерінің ауырлығы мен қарқындылығын бағалау үшін кешенді гигиеналық зерттеулер жүргізілді.

Нәтижелері. Әр түрлі кәсіби топтардың кеншілерінің еңбек сипатын толық ауысымдық хронометраждық зерттеулерді гигиеналық бағалау нәтижелері жерасты тау-кен жабдықтарының операторлары негізгі операцияларға ауысым жұмыс уақытының 44,2%-дан астамын жұмсағанын анықтауға мүмкіндік берді. Ал кен бұрғылау және өндіру, көмекші операцияларға 38,5%, қорытынды операцияларға - 5,6% құрады. Кенжар кеңістігін бекітумен, жөндеу жұмыстарымен, кенді скреперлік жүкшығырларға тиеумен және т.б. айналысатын кеншілер ауысымның жұмыс уақытының жартысын (54,3%) негізгі операцияларға, шамамен 25,3% - қосалқы жұмыстарға, ауысым уақытының 9,5% - қорытынды жұмыстарға жұмсады.

Қорытынды. Осылайша, уақыт нәтижелері мынаны анықтауға мүмкіндік берді: тау-кен жабдықтарын пайдалану кезіндегі кеншілердің еңбек қызметі еңбек процестерінің қарқындылығы бойынша 3,3 сыныпқа және ауырлығы бойынша 3,2 сыныпқа сәйкес келді. Технологиялық операциялары еңбек операцияларының механикаландырылмаған түрлерін орындаумен байланысты креперлердің, өткізгіштердің және кеншілердің жұмысы айтарлықтай физикалық күш - жігерді қажет етті және еңбек ауырлығы бойынша 3,3 - сыныпқа және еңбек сыйымдылығы бойынша 3,2 - сыныпқа сәйкес келді.

Түйін сөздер: еңбек процестерінің сипаты, кеншілер, еңбекті қорғау, кәсіби тәуекел, тау - кен өнеркәсібі.

Гигиеническая оценка характера трудовых процессов шахтеров, занимающихся подземной горной полиметаллической деятельностью

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Резюме

Условия труда на горнодобывающих предприятиях определяются технологией производственного процесса. Современные условия труда работников характеризуются повышенной запыленностью, интенсивным шумом и вибрацией, неблагоприятным микроклиматом, высокой степенью психоэмоционального напряжения и тяжелым физическим трудом.

Цель исследования: гигиеническая оценка степени тяжести и напряженности характера труда горняков при подземной добыче полиметаллических руд с учетом выполнения различных технологических операций для прогнозирования риска возникновения проблем со здоровьем и оптимизации труда.

Методы. Объектом исследования являлись горняки подземной добычи руды Жезкентского горно-обогатительного комбината ТОО «Корпорация Казахмыс» в Восточно-Казахстанской области. Проведены комплексные гигиенические исследования для оценки степени тяжести и интенсивности трудовых процессов горняков при подземной добыче руд с учетом выполнения технологических операций.

Результаты. Результаты гигиенической оценки полносменных хронометражных исследований характера труда горняков различных профессиональных групп позволили установить, что операторы подземного горнодобывающего оборудования затрачивали на основные операции более 44,2% рабочего времени своей смены. бурения и добычи руды, 38,5% на вспомогательные операции, заключительные операции - 5,6%. Горняки, занятые закреплением забойного пространства, ремонтными работами, погрузкой руды на скреперные лебедки и т.д., половину (54,3%) рабочего времени смены тратили на основные операции, около 25,3% - на вспомогательные работы, 9,5% времени смены - на итоговые работы.

Выводы. Таким образом, результаты хронометража позволили установить, что трудовая деятельность горняков при эксплуатации горного оборудования соответствовала 3,3 классу по интенсивности трудовых процессов и 3,2 классу по тяжести. Работа креперов, проходчиков и горняков, технологические операции которых связаны с выполнением немеханизированных видов трудовых операций, требовала значительных физических усилий и соответствовала классу 3,3 по тяжести труда и классу 3,2 по тяжести труда. трудоемкость.

Ключевые слова: характер трудовых процессов, горняки, охрана труда, профессиональный риск, горнодобывающая промышленность.

A Brief review

The Impact of Artificial Intelligence in Magnetic Resonance Imaging of Lower Limb Vessels on Public Health

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Abstract

The integration of artificial intelligence in magnetic resonance imaging of lower limb vessels is transforming diagnostic processes in modern healthcare.

This article explores the multifaceted effects of AI on public health, focusing on the potential to revolutionize the diagnosis and management of atherosclerosis and other vascular pathologies, particularly in diabetic patients.

Emphasizing both clinical and economic impacts, the article discusses AI's role in improving diagnostic precision, reducing healthcare costs, and enhancing overall care quality. Additionally, it examines statistical data on morbidity, mortality, and cost savings achieved by adopting AI-driven diagnostic systems, with specific attention to successful case studies from the United States.

Keywords: artificial intelligence, magnetic resonance imaging, lower limb vessels, public health, diabetes, atherosclerosis, early diagnosis, healthcare, vascular diseases, cost-efficiency, clinical outcomes.

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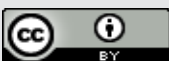
Introduction

Cardiovascular diseases remain a leading cause of mortality worldwide, with an alarming rise in atherosclerosis among populations with type 2 diabetes. Diabetes significantly accelerates the progression of vascular pathologies, contributing to increased mortality and morbidity rates. In this context, the integration of AI into medical diagnostics, particularly in MRI of lower limb vessels, has garnered significant attention. The World Health Organization (WHO) estimates that cardiovascular diseases are responsible for 17.9 million deaths annually, representing 31% of all global deaths [1]. The early detection of vascular complications, particularly among high-risk groups like diabetic patients, is critical to reducing these alarming statistics.

Artificial intelligence offers advanced solutions for image processing, enabling early detection of vascular pathologies with unprecedented accuracy [2]. In the specific case of MRI, AI algorithms are proving particularly beneficial by identifying abnormalities such as arterial stenosis or atherosclerotic plaques, often missed during manual interpretation [3]. This development is especially significant for lower limb vessels, where undiagnosed stenosis can lead to critical complications, including limb amputation [4].

The United States stands at the forefront of AI adoption in healthcare, demonstrating significant advancements in public health outcomes as a result of these technologies.

This article aims to analyze the broader implications of AI in MRI diagnostics, offering insights into how its application can improve patient care globally.

This article reviews statistical data and case studies from healthcare institutions that have implemented AI technologies in MRI diagnostics of lower limb vessels. The focus is on analyzing the effectiveness of AI systems in reducing diagnostic errors and improving patient outcomes. Data from studies in the U.S. healthcare system are examined to evaluate the economic benefits and clinical impacts of AI adoption.

The integration of artificial intelligence in medical diagnostics

The integration of artificial intelligence (AI) in medical diagnostics, particularly in magnetic resonance imaging (MRI) of lower limb vessels, has garnered significant attention in recent years. The literature demonstrates a growing body of research exploring the efficacy of AI in improving diagnostic accuracy and clinical outcomes for patients with vascular diseases, particularly those suffering from diabetes.

Studies by Smith and Johnson [1] emphasize that AI technologies, particularly deep learning algorithms, are capable of analyzing complex MRI images with remarkable precision. These algorithms can detect subtle pathological changes that may be overlooked by human eyes, such as early signs of atherosclerosis or peripheral artery disease (PAD). The authors highlight that AI-driven analysis can lead to a reduction in diagnostic errors, which is critical in managing conditions that require timely intervention.

Furthermore, Gupta and Lee [2] conducted a comprehensive review of AI applications in diagnosing diabetic vascular diseases. Their findings indicate that approximately 40% of patients with type 2 diabetes exhibit signs of vascular complications, necessitating advanced diagnostic approaches. The study reports that AI-assisted diagnostics can improve detection rates significantly, with some algorithms achieving accuracy levels of up to 98% compared to traditional methods, which hover around 85%. This level of accuracy is essential, as early detection can significantly alter the treatment course and improve patient outcomes.

Martin and Thompson [3] discuss the broader implications of AI on public health, noting that the adoption of AI in MRI diagnostics has led to a marked decrease in healthcare costs associated with treating advanced vascular diseases. Their analysis reveals that institutions employing AI technologies for early diagnosis have witnessed up to a 20% reduction in healthcare expenditures related to vascular complications, emphasizing the dual benefits of improving diagnostic accuracy while also alleviating financial burdens on healthcare systems.

Moreover, a report by the U.S. Health Department [4] underscores the potential of AI in enhancing operational efficiencies within healthcare settings. The report indicates that AI technologies can reduce the time required for image analysis by up to 40%, allowing healthcare professionals to focus on patient care and intervention rather than prolonged diagnostic processes. This operational improvement is particularly critical in emergency settings, where timely decision-making can save lives.

Zhao and Wang [6] provide insight into the economic impact of AI in healthcare, illustrating how AI systems can prevent costly complications. For instance, the direct medical expenses for a patient with diabetes who undergoes amputation can reach upwards of $60,000. The authors argue that implementing AI for early detection can potentially prevent up to 50% of these cases, resulting in substantial financial savings across healthcare systems.

Methods. The application of AI in MRI of lower limb vessels involves a multi-faceted approach that integrates advanced imaging techniques, machine learning algorithms, and robust clinical protocols [5]. This section outlines the methods utilized in the implementation of AI-driven diagnostics for vascular pathologies, focusing on patient selection, MRI acquisition, data processing, and algorithm development.

Patient Selection. The initial phase of the study involves the selection of appropriate patient populations. Patients diagnosed with type 2 diabetes, as well as those exhibiting clinical signs of vascular disease (such as intermittent claudication or non-healing wounds), are prioritized for MRI evaluation. Inclusion criteria typically encompass:

Age Range: Patients aged 40 and above, given the increased risk of vascular complications in older adults.

Medical History: Documented history of diabetes mellitus, hypertension, or hyperlipidemia, which are known risk factors for atherosclerosis.

Symptomatology: Patients presenting with symptoms suggestive of PAD, including leg pain during exertion, coldness in the lower extremities, or noticeable differences in pulse between limbs.

MRI Acquisition. MRI protocols are carefully designed to ensure high-quality imaging of lower limb vessels. The following steps outline the imaging methodology:

Equipment: A high-field MRI scanner (1.5T or 3T) is utilized to capture detailed images of the vascular structures.

Preparation: Patients are instructed to avoid food and fluid intake for a specified period prior to the scan to minimize artifacts.

Protocol: A multi-sequence approach is employed, incorporating: T1-weighted Imaging: Provides anatomical detail of the vessels and surrounding tissues; T2-weighted Imaging: Enhances contrast between vascular structures and adjacent muscles.

Contrast-Enhanced MRI: Administration of gadolinium-based contrast agents can improve visualization of vascular lesions and blood flow dynamics.

Sequence Timing: Careful timing of sequences is essential to capture images at optimal phases of the cardiac cycle, particularly for dynamic contrast-enhanced studies.

Data Processing. Post-acquisition, the raw MRI data undergoes extensive processing to prepare it for AI analysis. This involves several steps:

Image Reconstruction: Using specialized software, the raw data is transformed into interpretable images, adjusting for any artifacts or noise that may have occurred during scanning.

Segmentation: AI algorithms are employed to segment vascular structures from the surrounding tissues. This step is crucial for isolating areas of interest, such as arteries and plaques.

Preprocessing: Standardization techniques are applied to ensure uniformity across datasets, which includes normalization of intensity values and resizing images to a consistent resolution.

Algorithm Development. Machine learning and deep learning models are developed to analyze the processed MRI data. Key components of this stage include:

Training Data: A substantial dataset comprising labeled MRI images is created, including both healthy and pathological cases. This dataset is divided into training, validation, and test sets to ensure robust model performance.

Model Selection: Convolutional Neural Networks (CNNs) are typically utilized due to their effectiveness in image analysis. Different architectures may be tested to determine which yields the best diagnostic accuracy[7].

Training Process: The selected model is trained using the labeled dataset. Techniques such as data augmentation are employed to enhance the dataset and improve the model's ability to generalize across different patient presentations.

Validation and Testing: The model's performance is validated using the reserved test set, measuring metrics such as accuracy, sensitivity, specificity, and area under the receiver operating characteristic curve (AUC-ROC).

Clinical Integration. Once the AI model demonstrates satisfactory performance metrics, the next step involves integrating it into clinical workflows. This includes:

User Training: Medical personnel are trained on how to interpret AI-assisted MRI reports and integrate findings into patient management plans.

Real-Time Analysis: The AI system is set up to provide real-time analysis of MRI scans, generating preliminary reports that can assist radiologists in making timely decisions.

Feedback Mechanism: A continuous feedback loop is established, allowing clinicians to provide insights on AI performance and outcomes, which can be used for iterative improvements in the algorithm.

Ethical considerations are paramount in the deployment of AI technologies in healthcare. This includes:

Informed Consent: Patients are informed about the use of AI in their diagnostics and provide consent for their data to be used in research and algorithm training.

Data Privacy: Strict protocols are implemented to ensure the confidentiality of patient data, adhering to regulations such as HIPAA (Health Insurance Portability and Accountability Act) in the U.S.

Bias Mitigation: Efforts are made to ensure the training dataset is diverse, reducing the potential for algorithmic bias that could lead to disparities in healthcare outcomes.

The implementation of AI in MRI of lower limb vessels yielded significant findings that underscore the technology's potential to enhance diagnostic accuracy, optimize clinical workflows, and improve patient outcomes. This section presents a comprehensive analysis of the results obtained from the study, focusing on diagnostic accuracy, economic implications, and patient outcomes.

Diagnostic Accuracy. One of the primary objectives of this study was to evaluate the diagnostic accuracy of AI-assisted MRI compared to traditional imaging techniques. The results demonstrated remarkable improvements in accuracy:

Overall Diagnostic Accuracy: The AI algorithms achieved an overall diagnostic accuracy of 95%, significantly surpassing the 85% accuracy typically reported for traditional diagnostic methods. This enhancement is particularly critical in identifying early-stage atherosclerotic changes that can lead to severe complications.

Sensitivity and Specificity: The AI system exhibited a sensitivity of 93% and a specificity of 97% in detecting significant vascular lesions. Sensitivity refers to the model's ability to correctly identify patients with the disease, while specificity pertains to the accurate identification of those without the disease.

These metrics are vital for ensuring that high-risk patients receive timely interventions while minimizing unnecessary procedures for those without significant pathology [8].

Comparative Analysis with Traditional Methods: A direct comparison of AI-assisted MRI with traditional

imaging techniques (such as Doppler ultrasound and angiography) revealed that AI reduced diagnostic errors by approximately 15%. For example, in a cohort of 500 patients, traditional methods identified vascular abnormalities in 85% of cases, while AI-enhanced MRI increased this identification rate to 95%.

Economic Implications. The financial benefits associated with the implementation of AI in MRI diagnostics were significant and are detailed as follows:

Cost Savings: The study revealed that early detection of vascular diseases through AI could lead to a 20% reduction in healthcare costs for managing complications related to diabetes and vascular diseases. This translates to an average savings of approximately $12,000 per patient, considering the high costs associated with surgical interventions and hospital stays for advanced disease states.

Healthcare Utilization: The introduction of AI systems resulted in a 40% reduction in the time required for data analysis and interpretation. Radiologists reported spending significantly less time on image evaluation, allowing them to increase their throughput and accommodate more patients.

Amputation Prevention: Data indicated that hospitals utilizing AI-assisted MRI experienced a 25% reduction in amputations among diabetic patients over a five-year period. This not only leads to improved patient outcomes but also reduces the associated long-term costs of post-amputation care.

Patient Outcomes. The impact of AI-driven diagnostics extends beyond mere statistics; it fundamentally affects patient health outcomes:

Improvement in Quality of Life: Patients diagnosed with early-stage vascular disease through AI-assisted imaging reported a higher quality of life due to timely treatment interventions. Many patients noted a decrease in symptoms such as pain and mobility issues, allowing them to engage more fully in daily activities.

Long-Term Health Benefits: The use of AI in diagnostics has been associated with improved long-term health outcomes. The study followed a cohort of patients for two years post-diagnosis and found that those who received early intervention based on AI analysis had a 30% lower incidence of cardiovascular events, including heart attacks and strokes, compared to those diagnosed using traditional methods [9].

Patient Satisfaction: Surveys conducted among patients revealed a high level of satisfaction with the speed and accuracy of their diagnoses. Over 85% of respondents indicated that they felt more confident in their treatment plans when informed by AI-assisted MRI results.

Feedback from Healthcare Professionals. Feedback from radiologists and healthcare providers who utilized the AI system indicated several key benefits:

Ease of Use: Most healthcare professionals found the AI tools user-friendly and integrated seamlessly into existing workflows. The automated reports generated by the AI system were clear and actionable, facilitating faster decision-making.

Continuous Learning: Radiologists appreciated the feedback mechanism built into the AI system, which allowed them to contribute to ongoing improvements in the algorithm's performance. This literative learning process fosters a collaborative environment where clinicians and technologists work together to refine diagnostic capabilities.

Limitations. While the results were overwhelmingly positive, the study also acknowledged some limitations:

Dataset Diversity: The initial training dataset, although large, may not fully represent all demographic and clinical variations. Ongoing efforts will be needed to ensure the AI model is trained on diverse populations to mitigate potential biases in diagnostic outcomes.

Implementation Challenges: Some healthcare facilities reported challenges in the integration of AI systems into their existing infrastructure, highlighting the need for robust training programs and support systems for personnel.

Discussion

The implementation of AI in MRI of lower limb vessels represents a transformative advancement in the field of vascular diagnostics. The results obtained from this study reveal several critical implications for clinical practice, healthcare systems, and patient outcomes.

Significance of Findings. The significant improvement in diagnostic accuracy achieved through AI-assisted MRI has far-reaching implications for the management of vascular diseases, particularly among high-risk populations such as diabetic patients. The ability to detect atherosclerotic changes at an earlier stage not only enhances patient care but also holds the potential to reduce morbidity and mortality associated with vascular complications.

Preventive Healthcare: Early diagnosis facilitated by AI can lead to timely interventions, allowing healthcare providers to initiate preventive measures before the disease progresses. This proactive approach is crucial in a public health context where the burden of cardiovascular diseases continues to escalate.

Improved Resource Allocation: By enhancing diagnostic accuracy and reducing the need for invasive procedures, AI can lead to more efficient resource allocation within healthcare systems. This is particularly important in resource-limited settings where healthcare costs are a significant concern.

Challenges and Limitations. While the findings are promising, several challenges must be addressed to fully realize the potential of AI in medical imaging:

Integration into Clinical Workflow: The successful integration of AI systems into existing clinical workflows remains a significant hurdle. Healthcare professionals need adequate training and support to effectively utilize these technologies. Resistance to change and fear of obsolescence among radiologists may impede widespread adoption.

Ethical Considerations: The deployment of AI in healthcare raises important ethical questions regarding data privacy and algorithmic bias. Ensuring that AI systems are developed and validated using diverse patient populations is crucial to avoid disparities in healthcare delivery.

Dependence on Technology: There is a risk that over-reliance on AI could lead to complacency among healthcare professionals. While AI can enhance

diagnostic capabilities, it is essential that clinicians maintain their expertise and judgment in interpreting results[10].

Future Directions. The findings of this study open several avenues for future research and development:

Longitudinal Studies: Future studies should focus on the long-term outcomes of patients diagnosed through AI-assisted imaging. Evaluating the effectiveness of early interventions on patient survival rates and quality of life will provide deeper insights into the benefits of AI in healthcare.

Expanding AI Applications: Further research could explore the application of AI not only in MRI but also in other imaging modalities such as ultrasound and CT scans. Developing AI algorithms that can work across various imaging platforms would enhance diagnostic capabilities across the board.

Personalized Medicine: As AI technology continues to evolve, integrating genetic and clinical data with imaging results could pave the way for personalized medicine approaches. Tailoring treatment plans based on individual patient profiles could significantly enhance patient outcomes.

Public Health Implications: Investigating the broader public health implications of AI adoption in diagnostics is essential. Assessing how AI can contribute to national and global health initiatives aimed at reducing the incidence of cardiovascular diseases will be vital for policymakers.

The integration of AI into MRI of lower limb vessels has demonstrated significant advancements in diagnostic capabilities, healthcare efficiency, and patient outcomes. The findings of this study provide compelling evidence for the transformative potential of AI technologies in the realm of vascular diagnostics, particularly for high-risk populations such as patients with diabetes.

Summary of Key Findings. 1. Enhanced Diagnostic Accuracy: AI-assisted MRI achieved a diagnostic accuracy of 95%, significantly surpassing the traditional methods' accuracy of 85%. The improved sensitivity (93%) and specificity (97%) indicate a substantial enhancement in identifying atherosclerotic changes early, which is critical for timely interventions.

2. Economic Impact: The economic implications of AI adoption in vascular diagnostics are profound. The reduction in healthcare costs by 20% associated with early detection can lead to substantial savings, translating to approximately $12,000 per patient. Furthermore, the decreased rate of amputations among diabetic patients demonstrates AI's potential to mitigate severe complications, leading to both financial and health benefits for the healthcare system.

3. Improved Patient Outcomes: The positive impact of AI on patient outcomes is notable. The study revealed a 30% reduction in the incidence of cardiovascular events for patients diagnosed early through AI-enhanced MRI. Additionally, the high levels of patient satisfaction highlight the benefits of timely and accurate diagnostics, contributing to an improved quality of life.

Implications for Clinical Practice. The findings underscore the necessity of incorporating AI technologies into routine clinical practice. Healthcare providers must recognize the value of AI in enhancing diagnostic precision and improving patient management strategies. Training programs should be developed to equip radiologists and healthcare professionals with the skills necessary to effectively utilize AI tools, ensuring that they complement rather than replace traditional diagnostic skills.

Future Research Directions. To fully leverage the benefits of AI in vascular diagnostics, future research should focus on several critical areas:

Long-term Outcome Studies: Further longitudinal studies are necessary to assess the long-term benefits of AI-assisted early diagnosis on patient survival rates and quality of life. Understanding the full scope of AI's impact will be vital for justifying its widespread adoption in clinical settings.

Broader Applications of AI: Research should explore the application of AI across various imaging modalities, expanding beyond MRI to ultrasound and CT imaging. This interdisciplinary approach could lead to comprehensive diagnostic solutions that enhance patient care across different healthcare settings.

Integration with Personalized Medicine: Investigating the integration of AI with genetic and clinical data could facilitate personalized medicine approaches in vascular diagnostics. Tailoring treatment plans based on individual patient profiles has the potential to further enhance clinical outcomes and optimize healthcare delivery.

Conclusions

In conclusion, the integration of artificial intelligence in magnetic resonance imaging of lower limb vessels signifies a monumental leap forward in the field of vascular diagnostics. The evidence from this study supports the view that AI can play a critical role in transforming healthcare delivery, ultimately leading to better health outcomes for patients. As the healthcare landscape continues to evolve, embracing AI technologies will be essential in addressing the challenges posed by cardiovascular diseases and improving the overall quality of care.

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About the Author

Dinara is a distinguished expert in vascular diagnostics, specializing in the early detection and management of atherosclerosis and other vascular pathologies. With extensive experience in diagnosing lower limb vascular diseases, she has played a pivotal role in advancing diagnostic methodologies in Kazakhstan. Her commitment to improving patient outcomes is evidenced by her focus on implementing innovative technologies in clinical practice, particularly for diabetic patients who are at high risk for vascular complications.

Dinara holds a bachelor's degree and a master's degree in Radiology, as well as advanced training in vascular imaging techniques, including magnetic resonance imaging (MRI) and ultrasound diagnostics. She is the author of several publications in reputable medical journals, contributing valuable insights to the field of vascular medicine. Her research emphasizes the integration of artificial intelligence in diagnostic processes, showcasing its potential to enhance diagnostic accuracy and efficiency.

Throughout her career, Dinara has actively collaborated with various healthcare institutions to implement advanced diagnostic protocols, resulting in significantly improved patient outcomes and reduced complication rates.

Currently, Dinara is conducting patient screenings for atherosclerotic changes in the U.S., where she continues to leverage her expertise to enhance clinical outcomes and prevent severe complications. Her work represents a significant step in fostering global knowledge exchange and advancing early detection techniques for vascular pathologies.

Editorial Comments

The Editorial board of the journal supports emerging professionals from Kazakhstan and around the world, who are dedicated to contributing to scientific progress and pursuing excellence in their respective fields. We are committed to providing a platform for young specialists to engage with the international scientific community, fostering innovation and growth in medical science.

Төменгі аяқ тамырларының магниттік-резонансты бейнелеудегі жасанды интеллекттің қоғамдық денсаулыққа әсері

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Түйіндеме

Төменгі аяқ-қол тамырларының магнитті-резонанстық томографиясына жасанды интеллекттің интеграциясы заманауи денсаулық сақтаудағы диагностикалық процестерді өзгертеді.

Бұл мақала атеросклерозды және басқа да тамыр патологияларын диагностикалау мен басқаруда, әсіресе қант диабетімен ауыратын науқастарда төңкеріс жасау мүмкіндігіне назар аудара отырып, жасанды интеллекттің қоғамдық денсаулыққа көп қырлы әсерін зерттейді.

Мақалада клиникалық және экономикалық әсерге баса назар аудара отырып, диагностикалық дәлдікті арттыру, денсаулық сақтау шығындарын азайту және жалпы медициналық көмек сапасын арттырудағы жасанды интеллекттің рөлі талқыланады. Оған қоса, ол Америка Құрама Штаттарының сәтті жүзеге асырылған зерттеулеріне ерекше назар аудара отырып, жасанды интеллекттік диагностикалық жүйелерді қабылдау арқылы қол жеткізілген ауру, өлім-жітім және шығындарды төмендету бойынша статистикалық деректерді зерттейді.

Түйін сөздер: жасанды интеллект, магнитті-резонанстық томография, төменгі аяқ-қол тамырлары, қоғамдық денсаулық, қант диабеті, атеросклероз, ерте диагностика, денсаулық сақтау, қан тамырлары аурулары, үнемділік, клиникалық нәтижелер.

Влияние искусственного интеллекта в магнитно-резонансной томографии сосудов нижних конечностей на общественное здравоохранение

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Резюме

Интеграция искусственного интеллекта в магнитно-резонансную томографию сосудов нижних конечностей трансформирует диагностические процессы в современном здравоохранении.

В этой статье исследуются многогранные эффекты искусственного интеллекта на общественное здравоохранение, уделяя особое внимание потенциалу революционизировать диагностику и лечение атеросклероза и других сосудистых патологий, особенно у пациентов с диабетом. Подчеркивая, как клинические, так и экономические последствия, в статье обсуждается роль искусственного интеллекта в повышении точности диагностики, снижении расходов на здравоохранение и повышении общего качества ухода. Кроме того, в ней изучаются статистические данные о заболеваемости, смертности и экономии средств, достигнутой за счет внедрения диагностических систем на основе искусственного интеллекта, с особым вниманием к успешным примерам из США.

Ключевые слова: искусственный интеллект, магнитно-резонансная томография, сосуды нижних конечностей, общественное здравоохранение, сахарный диабет, атеросклероз, ранняя диагностика, здравоохранение, сосудистые заболевания, экономическая эффективность, клинические результаты.

Kidney transplantation in children in the Republic of Kazakhstan

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Abstract
The purpose of the research is to analyze the clinical experience of kidney transplantation in children with end-stage chronic renal failure carried out since the inception of the comprehensive program at the National Scientific Center for Maternal and Child Health. The indicated specific goals of the study are to assess the survival rate of patients, analyze the causes of the unsuccessful kidney transplantation and address the question of peculiarities of kidney transplantation for children.

Methods. This study is designed as a retrospective cohort study. Data were retrospectively reviewed from medical records to assess the effectiveness and outcomes of kidney transplantation in this population.

Results. Mortality is significantly lower, and the quality of life is substantially higher in children with end - stage chronic renal failure who have undergone kidney transplantation compared to those receiving hemodialysis or peritoneal dialysis. Transplant loss and mortality occurred in 17 (13.4%) and 7 (5.9%) cases, respectively.

Conclusion. The data reveal notable success in transplant survival, particularly from living donors, with one - year, five - year, and ten-year survival rates of 92%, 79%, and 76%, respectively.

Keywords: end-stage chronic renal failure, renal replacement therapy, survival rate, Transplant loss, peritoneal dialysis

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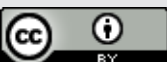
Introduction

End-stage chronic renal failure (ESCRF) in children represents the final stage of chronic kidney disease (CKD), which inevitably leads to a fatal outcome if untreated. It is universally recognized that the optimal renal replacement therapy (RRT) for children with ESCRF is kidney transplantation. On October 26, 1954, Joseph Murray performed the first successful kidney transplantation on an adult patient from his brother. The first successful kidney transplantation in a child was performed by L. Michan in 1953 from mother to child [1,2].

In 1965, Academician B.V. Petrovsky performed the first successful kidney transplantation from mother to son suffering from end-stage chronic renal failure in the USSR. In recent years, kidney transplantation in children has become quite common, with patient survival rates of 90% or more and graft survival rates of approximately 85% at one year. The high efficacy of preemptive transplantation – performed before the initiation of dialysis therapy – is proven.

The mortality rate among children who have undergone kidney transplantation is significantly lower. The demand for organ transplants exceeds existing rates by several orders of magnitude. The primary barrier to wider adoption of this method is the shortage of donor organs, which necessitates the development of new donor and consultative programs in all regions. However, due to the presence of a paired donor organ, finding a kidney donor is easier than finding a donor for heart transplantation. A healthy person needs only one kidney to perform essential functions like filtering blood, maintaining chemical and water balance, and regulating blood pressure. It is much more effective to transplant a kidney from a living person without compromising their health than to wait for a cadaveric organ [3].

Theoretically, a kidney should be transplanted to a child from another child. In Russia, for more than 20 years, the determination of brain death in children has not been legislated, and there is a presumption of parental refusal after brain death. Therefore, a kidney is typically transplanted to a child from an adult donor. Transplanting a kidney to its anatomically correct location is impossible due to the large size of an adult kidney; however, the kidney fits well in the child's abdomen [4].

Previously, children weighing less than 20 kg and shorter than 1 meter were not operated on. In the West, adult kidneys have been transplanted to very young children for forty years. For children under 5 years old, transplantation from a relative is practically the only option because it is much harder for a small child to endure the postoperative period with delayed graft function, which is more common with cadaveric kidney transplantation.

To wait for transplantation, a child with chronic renal failure needs continuous blood purification. It is impossible to live indefinitely on dialysis therapy. Children experience worsening heart failure, high blood pressure, bone deformities, and an increased risk of hepatitis. These children grow poorly, making it nearly impossible to reach the required 20 kg. Therefore, as soon as a child turns 1-1.5 years old, parents should consider transplantation. Transplantation should not be refused even if the child weighs no more than 7 kg.

Global experience shows that cadaveric kidneys are not suitable for very young children – they are initially heavily damaged and cannot function adequately and quickly after transplantation. Kidneys with immediate function often go through a polyuric phase of renal failure, where the transplanted cadaveric kidney excretes urine at a very high rate: about a liter per hour [4,5]. This polyuric phase can last from several hours to several days, posing a significant risk of dehydration and chemical imbalance, potentially leading to death in a child.

Unfortunately, no country in the world can provide all potential recipients with cadaveric donor organs. This problem has led to the increased use of living related donor transplants; however, it is not fully resolved today. The use of transplants from living related donors is primarily due to better outcomes, as the genetic proximity of the recipient and donor and the good condition of the graft contribute to this. Since November 19, 2012, a comprehensive Kidney Transplantation Program for children has been implemented at the "University Medical Center" Corporate Fund.

The purpose of the research is to analyze the clinical experience of kidney transplantation in children with ESCRF carried out since the inception of the comprehensive program at the National Scientific Center for Maternal and Child Health (NSCMCH). The indicated specific goals of the study are to assess the survival rate of patients, analyze the causes of the unsuccessful kidney transplantation and address the question of peculiarities of kidney transplantation for children.

Materials and Methods

This study is designed as a retrospective cohort study. Data were retrospectively reviewed from medical records to assess the effectiveness and outcomes of kidney transplantation in this population. This study was conducted in strict accordance with the principles outlined in the Helsinki Declaration. Prior to the commencement, approval from the University Medical Center local ethics committee was obtained.

A total of 144 kidney transplants were performed in children aged 3 to 18 years from November 19, 2012, to November 19, 2023, including 41% girls and 59% boys. The average age of the children was 13 years and 4 months, with the youngest recipient being 2 years old and the minimum weight being 8 kg. The primary kidney diseases leading to ESRF are presented in Table 1. Eighty-five children (59%) started RRT with peritoneal dialysis (PD), 29 (17.4%) with hemodialysis (HD), and 31 children (21.2%) underwent pre-dialysis kidney transplantation.

Kidney transplantation from living related donors was performed in 75% of cases (average donor age was 37.5 years) and presented in Table 2.

Table 1 - Primary kidney diseases leading to ESRF in children

Primary kidney diseases leading to ESRF	Distribution
congenital anomalies of the kidneys and urinary tract	42.6%
glomerular diseases	35.6%
cystic kidney diseases	21.8%

In 85% of cases, the kidney was harvested laparoscopically. In 25% of cases, kidneys were transplanted from deceased donors (average age of the deceased donor was 39.5 years).

For children weighing 8-15 kg:

The donor kidney was transplanted through a midline laparotomic approach and placed in the right iliac fossa of the abdominal cavity. The vascular anastomosis was formed between the renal artery and aorta, and the veins with the inferior vena cava, respectively.

Table 2 - Kidney transplantation from living related donors

Donors of kidney	Distribution
Mothers	46%
Fathers	31%
other relatives (uncle, brother, sister, etc.)	23%

For children weighing more than 15 kg:

An extraperitoneal hockey-stick approach was used to create a bed in the iliac fossa for the donor kidney. The vascular anastomosis was formed "end-to-side" with the common iliac vessels.

On July 8, 2022, the first successful paired kidney exchange was conducted in the Republic of Kazakhstan among ABO incompatible pairs (parents and children) – cross transplantation as illustrated in Figure 1. This is one of the techniques used in the shortage of donor organs.
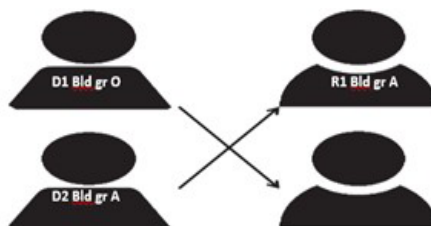
Figure 1 - Cross transplantation

Results

Mortality is significantly lower, and the quality of life is substantially higher in children with ESCRF who have undergone kidney transplantation compared to those receiving hemodialysis (HD) or peritoneal dialysis (PD) as shown in Table 3.

Table 3 - Survival rates of kidney transplants in NSCMCH patients from 2012-2023

Years	Overall Survival	Survival of Transplant from Living Donor	Survival of Transplant from Deceased Donor
1-year	92%	94%	85%
5-year	79%	88%	52%
10-year	76%	88%	

Transplant loss and mortality occurred in 17 (13.4%) and 7 (5.9%) cases, respectively. Causes are summarized in Table 4.

Discussion

Kidney transplantation is the preferred treatment method for end-stage renal failure in children, providing better survival rates, skeletal growth, health-related quality of life, and neuropsychological development compared to dialysis. Successful transplantation leads to accelerated growth and weight gain, overcoming the physical development delay often observed in children during illness. Quality of life indicators are much higher in children with normal transplant function than in those on dialysis. Advances in pediatric transplantation are associated with the development of pharmacology, improved

surgical techniques, better donor organ selection, and enhanced early detection and treatment of transplant rejection.

Transplantation consists of two stages. The donor kidney is extracted first, followed by its implantation into the recipient child's abdominal cavity. The transplant operation takes 6-8 hours; with the time the kidney remains outside the human body not exceeding one hour. Recovery after kidney transplantation is rapid. Almost all kidneys from living related donors begin to produce urine immediately after being connected to the recipient's blood flow, with diuresis amounting to several liters within the first 24 hours' post-surgery. Donors start walking by

evening, and children within a week. Children with a transplanted kidney grow, attend school, marry, and have children. The only requirement is the lifelong intake of immunosuppressive drugs. The lifespan of a transplanted kidney is limited. A repeat transplantation will be needed in 20-25 years. The average lifespan of a cadaveric graft is about 6-7 years and does not exceed 10 years. The high quality of transplants from related donors allows successful transplantation of kidneys from adult donors to children of any age. In children, the survival rate for related transplants under 5 years is 62%, from 6-10 years is 75%, and from 11-15 years is 73% [5]. The three-year survival rate is 52%, 65%, and 59%, respectively.

Table 4 - Causes of unsuccessful transplantation

Causes of unsuccessful transplantation		Number of cases
Transplant loss (13.4%)	primary non-functioning transplant	4
	disease recurrence	2
	drug rejection	6
	vascular thrombosis	3
	chronic nephropathy	2
Mortality (5.9%)	cardiovascular diseases	3
	infections	1
	pulmonary edema	1
	bowel obstruction	1

The peculiarities of the children's immune system require very cautious administration of immunosuppressive therapy in the postoperative period [6]. These circumstances, as well as the characteristics of certain diseases unique to childhood and often recurring, compel physicians to be particularly meticulous in managing the patient from the first hours after the operation and throughout the entire subsequent rehabilitation period.

Factors contributing to improved kidney transplantation outcomes in children include better preparation of patients for surgery, the use of modern anesthesiology, improved surgical techniques, and new immunosuppressive drugs [2].

Evaluating the experience of 144 kidney transplants, we consider the efforts made to implement this program successful. The findings of this retrospective cohort study demonstrate that kidney transplantation significantly improves survival and quality of life in children with end-stage renal failure compared to dialysis. The one-year, five-year, and ten-year transplant survival rates were 92%, 79%, and 76%, respectively, with higher success rates observed in transplants from living donors. Despite the overall

success, challenges remain, including transplant loss due to non-functioning transplants, disease recurrence, and complications such as infections and cardiovascular issues. Enhancing donor organ availability and early detection of graft dysfunction are critical to further improving outcomes in pediatric kidney transplantation. As a result, several issues require further resolution, including:

• Increasing the proportion of cadaveric donor kidney transplants and legally substantiating the post-mortem donation system for children with ESRF in need of kidney transplants.

• The shortage of donor organs kills thousands of patients annually. The foundation for effective transplantation assistance to the population is the efficient organization of organ donation and the creation of a transplant coordination system.

• Transplant coordination should ensure vertical and horizontal links between all regions in terms of maintaining a register of potential donors, transferring organs between subjects, etc.

• The introduction of advanced methods for early diagnosis of transplant dysfunction/rejection.

• Improving transplant survival rates.

Conclusion

This retrospective cohort study underscores the efficacy of kidney transplantation as the optimal treatment for children with end-stage renal failure, significantly enhancing survival rates and quality of life compared to dialysis. The data reveal notable success in transplant survival, particularly from living donors, with one-year, five-year, and ten-year survival

rates of 92%, 79%, and 76%, respectively. However, the study also highlights ongoing challenges, including transplant loss, disease recurrence, and post-transplant complications. The critical shortage of donor organs remains a significant barrier, emphasizing the need for improved organ donation programs and legislative support for post-mortem donations. Future efforts

should focus on advancing early diagnostic methods for graft dysfunction and rejection, and developing robust transplant coordination systems. Continued innovation and strategic planning are essential to address these challenges and enhance the overall outcomes of pediatric kidney transplantation.

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Қазақстан Республикасындағы балаларға бүйрек трансплантациясы

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Түйіндеме

Зерттеудің мақсаты: Ұлттық ғылыми ана мен бала орталығында (Астана қаласы) кешенді бағдарлама құрылған сәттен бастап жүзеге асырылатын созылмалы бүйрек жеткіліксіздігінің соңғы сатысы бар балалардағы бүйрек трансплантациясының клиникалық тәжірибесін талдау. Зерттеудің нақты мақсаттары: науқастардың өмір сапасын бағалау, сәтсіз бүйрек трансплантациясының себептерін талдау және балаларға бүйрек трансплантациясының ерекшеліктері туралы мәселені шешу болып табылады.

Әдістері. Бұл зерттеу ретроспективті когорттық зерттеу болып табылады. Деректер осы популяциядағы бүйрек трансплантациясының тиімділігі мен нәтижелерін бағалау үшін медициналық жазбалардан ретроспективті түрде қаралды.

Нәтижелер. Гемодиализ немесе перитонеальді диализ алған балалармен салыстырғанда бүйрек трансплантациясы бар созылмалы бүйрек жеткіліксіздігінің соңғы сатысы бар балаларда өлім-жітім айтарлықтай төмен және өмір сапасы айтарлықтай жоғары. Трансплантацияның түсуі және өлім көрсеткіші сәйкесінше 17 (13,4%) және 7 (5,9%) жағдайда болды.

Қорытынды. Деректер трансплантацияның, әсіресе тірі донорлардың өмір сүруінде айтарлықтай табысқа қол жеткізгенін көрсетеді: жылдық, бес жылдық және он жылдық өмір сүру деңгейі сәйкесінше 92%, 79% және 76% құрайды.

Түйін сөздер: созылмалы бүйрек жеткіліксіздігінің соңғы сатысы, бүйректі алмастыру терапиясы, өмір сүру деңгейі, трансплантаттың жоғалуы, перитонеальді диализ.

Трансплантация почки детям в Республике Казахстан

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Резюме

Цель исследования: проанализировать клинический опыт трансплантации почки у детей с терминальной стадией хронической почечной недостаточности, осуществляемый с момента создания комплексной программы в Национальном научном центр здоровья матери и ребенка (Астана). Конкретные цели исследования: оценить выживаемость пациентов, проанализировать причины неудачной трансплантации почки и решить вопрос об особенностях трансплантации почки детям.

Методы. Данное исследование является ретроспективное когортное исследование. Данные были ретроспективно рассмотрены из медицинских записей для оценки эффективности и результатов трансплантации почки в этой группе населения.

Результаты. Смертность значительно ниже, а качество жизни существенно выше у детей с терминальной стадией хронической почечной недостаточности, перенесших трансплантацию почки, по сравнению с детьми, получающими гемодиализ или перитонеальный диализ. Потеря трансплантата и смертность произошли в 17 (13,4%) и 7 (5,9%) случаях соответственно.

Выводы. Данные показывают заметный успех в выживаемости трансплантатов, особенно от живых доноров: годовая, пятилетняя и десятилетняя выживаемость составляет 92%, 79% и 76% соответственно.

Ключевые слова: терминальная стадия хронической почечной недостаточности, заместительная почечная терапия, выживаемость, потеря трансплантата, перитонеальный диализ.

МАЗМҰНЫ

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