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IS DRUG-RESISTANT TUBERCULOSIS HARDER TO CURE? TREATMENT OUTCOMES IN KAZAKHSTAN, WHO DATA FOR THE COHORTS OF 2015-2022

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Abstract: Kazakhstan has one of the highest shares of rifampicin-resistant tuberculosis (TB) among new patients in the world. This paper compares, with public WHO data, the treatment outcomes of people treated for drug-susceptible TB (new and relapse cases, cohorts 2015-2023) and for drug-resistant TB (MDR/RR-TB together with the separately reported XDR cohorts, 2015-2022). Treatment success for drug-susceptible TB was 87.8-91.1% in every year; for drug-resistant TB it was 75.5-82.7%. In every cohort from 2016 to 2022 it was lower for drug-resistant TB, by 7.2 to 14.5 percentage points, and the share of patients who died was 1.3-1.9 times higher; the 2015 drug-susceptible cohort is not comparable with later years. In an exploratory comparison, the drug-resistant cohorts of 2021-2022 had the best results: 81.9% success against 76.2% in 2019-2020 and 77.4% in all cohorts of 2015-2020 pooled, although both years stay within the range expected from the earlier year-to-year variation; success for drug-susceptible TB was practically unchanged against 2019-2020 (+0.1 points). Of the 5.8-point rise against 2019-2020, the share without an evaluated outcome fell by 3.5 points and treatment failure by 1.5; the share who died hardly changed (11.5% and 11.2%), and among patients with an evaluated outcome success rose by 3.0 points. The improvement coincided with a jump in the share of drug-resistant patients started on bedaquiline, from 25% in 2020 to 89% in 2021. The data support the idea that drug-resistant TB is harder to cure, and are consistent with, but cannot prove, a role of the new drugs.

Keywords: tuberculosis; multidrug-resistant tuberculosis; treatment outcomes; bedaquiline; Kazakhstan; WHO data.

1. Introduction

Tuberculosis (TB) is treated with a course of several antibiotics. Most patients have drug-susceptible TB and are treated with first-line drugs. When the bacteria do not respond to rifampicin, the most important of these drugs, the disease is called rifampicin-resistant TB (RR-TB); when they resist both rifampicin and isoniazid, it is multidrug-resistant TB (MDR-TB). Such patients need second-line drugs, such as bedaquiline and fluoroquinolones, which cost more (US$ 200-600 per person for the regimens, against about US$ 50 for first-line treatment) and may cause more adverse events [1]. Pre-extensively drug-resistant TB (pre-XDR-TB) adds resistance to a fluoroquinolone, and extensively drug-resistant TB (XDR-TB) adds resistance to bedaquiline or linezolid as well [1].

Kazakhstan is one of the countries where this matters most. In WHO estimates, TB incidence in Kazakhstan fell from 168 per 100,000 people in 2000 (95% uncertainty interval 137-203) and 78 in 2015 to 45 in 2024 (36-54), and the estimated number of incident RR-TB cases fell from 4,900 in 2015 to 3,600 in 2024. Yet the share of new TB patients with RR-TB rose from 29% to 33%, the fourth highest of the 182 countries with a 2024 estimate, after Belarus (39%), the Russian Federation (37%) and Turkmenistan (35%); among previously treated patients it was 54% in 2015 and 55% in 2024 [2].

Whether a person is cured matters for survival. In a cohort of people with both HIV and TB in Almaty, the estimated survival time of the 521 co-infected patients was longer when TB treatment succeeded than when it failed or the patient was lost to follow-up (128 against 37 months) [3]. Akhmedullin and co-authors studied 12,698 adults treated for drug-resistant TB, almost all of them MDR-TB, in Kazakhstan in 2018-2021 from the National Tuberculosis Registry: 81.16% had a successful outcome, and most unsuccessful outcomes were deaths (1,570 of 2,392) [4]. Ryskulov and co-authors analysed 93,985 TB cases registered in 2014-2023 and found that unfavorable outcomes were more likely in 2020-2021 and less likely in 2022-2023 than in 2014-2016, but their registry extract did not contain drug resistance, which they name as a major limitation [5]. WHO country profiles give the success rates of both groups each year, but neither study compares the outcomes of drug-susceptible and drug-resistant TB side by side over the same years. This paper does that for 2015-2023 with the treatment outcome data that Kazakhstan reports to WHO, and asks whether the gap between the two changed after new drugs for drug-resistant TB came into use.

2. Hypothesis

The research direction came with the first figures above on incidence and on the share of RR-TB. Asked why TB was declining while the drug-resistant share was rising, the author first guessed (16 October 2026) that TB was falling because children are vaccinated and that resistance was growing because antibiotics are taken incorrectly. Her scientific supervisor then checked these guesses against WHO data (22 October 2026): BCG vaccination of one-year-olds fell from 95% in 2014 to 86% in 2024 [6] while TB incidence kept falling [2], so vaccination alone does not explain the decline (BCG mainly protects young children against severe forms of TB, so infant coverage would be expected to have little effect on national incidence over these years), and resistance was more common among previously treated patients (54-55%) than among new ones (29-33%) [2], which fits the second part. He suggested that the drug-resistant share grows because drug-susceptible TB declines faster, and asked her why that might be. Before the treatment outcome data were compiled, the author answered (26 October 2026, translated from Russian): "I think that resistance of bacteria to drugs may develop because antibiotics are taken incorrectly, for example if treatment is interrupted or the doctor's recommendations are not followed. Ordinary tuberculosis is perhaps going away faster because it is easier to cure with pills, while resistant bacteria are harder to destroy and it takes longer, using special drugs."

The testable part of this hypothesis is that treatment success is lower for drug-resistant TB than for drug-susceptible TB in every cohort year; the paper also compares deaths. The second question, why results for drug-resistant TB were better in the 2021-2022 cohorts, was raised when her mentor made the first chart of outcomes (2 November 2026). This comparison was chosen after the data were seen, so it is exploratory; the author's explanation is quoted in Section 5.

3. Data and methods

All data are the files that WHO publishes for every country: treatment outcomes, case notifications, TB burden estimates, MDR/RR-TB burden estimates and the data dictionary, downloaded on 10 November 2026 from WHO's 2025 data collection round [2]; WHO's next round, with the 2026 global report, was due on 12 November 2026 and is not included, and BCG coverage from the Global Health Observatory [6]. A cohort is the group of patients who started treatment in a given year; its outcome is reported later, after treatment ends. The latest cohorts with outcome data are 2023 for drug-susceptible TB and 2022 for drug-resistant TB, as in the WHO global report [1, 7].

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Groups. Drug-susceptible TB is the cohort of new and relapse cases (variables newrel_coh, newrel_succ, newrel_fail, newrel_died, newrel_lost); WHO describes these as people treated with first-line regimens [7]. Kazakhstan includes relapse cases in this group in every year. From 2016 this cohort is smaller than the number of notified new and relapse cases (c_newinc): it covered 55-69% of them in 2016-2023. In 2015 it equalled all 14,006 notified cases, which suggests that patients later treated for drug-resistant TB were also counted in it. The 2015 drug-susceptible figures are therefore shown but not used in the comparisons. Coverage also varied from 2016 (55-69%), so the composition of the drug-susceptible cohort is not fixed either. Drug-resistant TB is reported in two columns, the MDR/RR-TB cohort (mdr_*) and the XDR-TB cohort (xdr_*). Their content changed in 2020. In that year the XDR cohort (1,178) equals the number of patients who started treatment for pre-XDR-TB or XDR-TB, and the MDR cohort (3,400) the number with no known fluoroquinolone resistance; the definitions of pre-XDR-TB and XDR-TB were revised in early 2021 [8], before the 2020 cohort's outcomes were reported, and before 2020 the XDR column appears, from these counts, to have held only XDR-TB in its earlier definition, so patients with fluoroquinolone resistance alone were counted as MDR (this is our inference; WHO does not describe how countries filled the columns). The main drug-resistant series therefore adds the two columns together. The split between the columns is not stable in other years either: in 2019 the XDR cohort (655) exceeds the 403 patients who started XDR-TB treatment, and in 2021 it is 235 against 469 who started treatment for pre-XDR-TB or XDR-TB. The MDR column alone, which is the figure WHO quotes, is therefore shown only as an indication. The drug-resistant cohort also differs from year to year in who is included: in 2015, 2017, 2018, 2020 and 2022 it equals the number of patients with laboratory-confirmed resistance who started treatment, in 2016 and 2019 it equals all patients who started treatment, including those without laboratory confirmation, and in 2021 it lies between the two (4,398 against 3,872 and 4,654). Year-to-year changes in this series may therefore partly reflect who was counted.

Outcomes. Treatment success is the sum of "cured" and "treatment completed". The other outcomes are "treatment failed", "died", "lost to follow-up" and "not evaluated" (no outcome assigned); "not evaluated" was computed as the cohort minus the four reported outcomes. From the 2020 cohort onward Kazakhstan reports outcomes with the revised WHO definitions of 2021 (variable used_2021_defs_flg = 1, as flagged for the 2020 row) [9, 10]. For drug-resistant TB the earlier definition of "treatment failed" required a permanent change of at least two drugs, for reasons that included no culture conversion by the end of the intensive phase [9, p. 2]; the revised one no longer depends on these phases, "lost to follow-up" now includes patients who did not start treatment, and "died" now includes deaths before treatment started [9, p. vii] [10]. Deaths are counted during treatment, which lasts much longer for drug-resistant TB, so the ratio of the shares who died partly reflects a longer period of observation and is not a ratio of death risks over the same time; the drug-resistant group also includes previously treated patients. Comparisons of 2021-2022 with 2020 are therefore made under the same definitions, although not necessarily with the same composition of the cohort; 2020 and 2022 are the closest pair, both limited to laboratory-confirmed patients.

New drugs. The notification file reports how many patients started bedaquiline in each year (mdrxdr_bdq_tx, available for 2017-2021), delamanid (2017-2018), longer all-oral regimens (2019 and 2023) and shorter all-oral regimens (2021-2023). The share on bedaquiline was computed against everyone who started treatment for drug-resistant TB that year, including patients without laboratory confirmation.

Statistics. Proportions are given with Wilson 95% confidence intervals and differences between proportions with Newcombe intervals. The cohorts are whole national cohorts, not samples, and these intervals describe only binomial variation within one year. They understate the real uncertainty: drug-resistant success in 2015-2020 varied between years far more than binomial variation allows (between-year standard deviation 2.0 points; heterogeneity chi-squared 62.7 with 5 degrees of freedom). Comparisons between periods are therefore described, not tested, and no p-values are given; the most recent cohorts are also placed against the mean and between-year

standard deviation of the earlier ones. Because the 2019-2020 baseline was chosen after the first chart was seen, the comparison is repeated against 2017-2018 and against all cohorts of 2015-2020. All calculations were done in Python; for drug-susceptible TB the success rates computed here agree with WHO's own rounded rate (c_new_tsr) in every year.

4. Results

4.1 Drug-susceptible and drug-resistant TB, year by year

Table 1 gives the outcomes of each cohort. Treatment success for drug-susceptible TB stayed between 87.8% and 91.1%. For drug-resistant TB it ranged from 75.5% in 2015 to 82.7% in 2022. In every comparable cohort, 2016 to 2022, it was below drug-susceptible TB, by 7.2 to 14.5 percentage points (14.5 in 2019, 7.4 in 2021 and 7.2 in 2022; Figure 1). Death was also more common with drug-resistant TB in each of these cohorts: 8.7-13.0% against 4.9-8.0%, a ratio of 1.3 (2022) to 1.9 (2017). In 2015 the gap was 15.1 points and the death ratio 2.1, but the drug-susceptible cohort of that year is not comparable (Section 3).

Table 1. Treatment outcomes of TB cohorts in Kazakhstan by the year treatment started.

Cohort	DS-TB: n	DS-TB: success, %	DS-TB: died, %	DR-TB: n	DR-TB: success, % (95% CI)	DR-TB: died, %	MDR column: success, %
2015	14,006	90.6	4.8	6,873	75.5 (74.5-76.5)	10.1	78.1
2016	6,775	88.0	6.5	6,695	77.5 (76.4-78.4)	8.7	79.5
2017	8,589	91.1	4.9	5,638	79.5 (78.5-80.6)	9.3	81.3
2018	7,859	90.3	6.0	4,722	80.3 (79.1-81.4)	9.4	80.7
2019	7,429	90.2	5.8	6,547	75.8 (74.7-76.8)	10.4	76.1
2020	5,742	87.8	8.0	4,578	76.8 (75.5-78.0)	13.0	75.9
2021	5,621	88.7	7.7	4,398	81.3 (80.2-82.5)	12.3	81.6
2022	5,922	89.9	7.5	3,556	82.7 (81.4-83.9)	9.9	84.1
2023	5,795	90.4	6.7	-	-	-	-

Note: DS-TB, drug-susceptible TB (new and relapse cases); DR-TB, the MDR/RR-TB and XDR-TB cohorts together; n, cohort size. The 2015 DS-TB cohort equals all notified new and relapse cases (from 2016, 55-69% of them) and is not comparable with later years. Intervals are within-year binomial intervals and understate the uncertainty between years; for DS-TB success they are 0.5-0.9 points wide on each side. The MDR column is shown only as an indication (Section 3). Outcomes for the 2023 DR-TB cohort were not yet in the files downloaded on 10.11.2026. Source: own calculations from [2].

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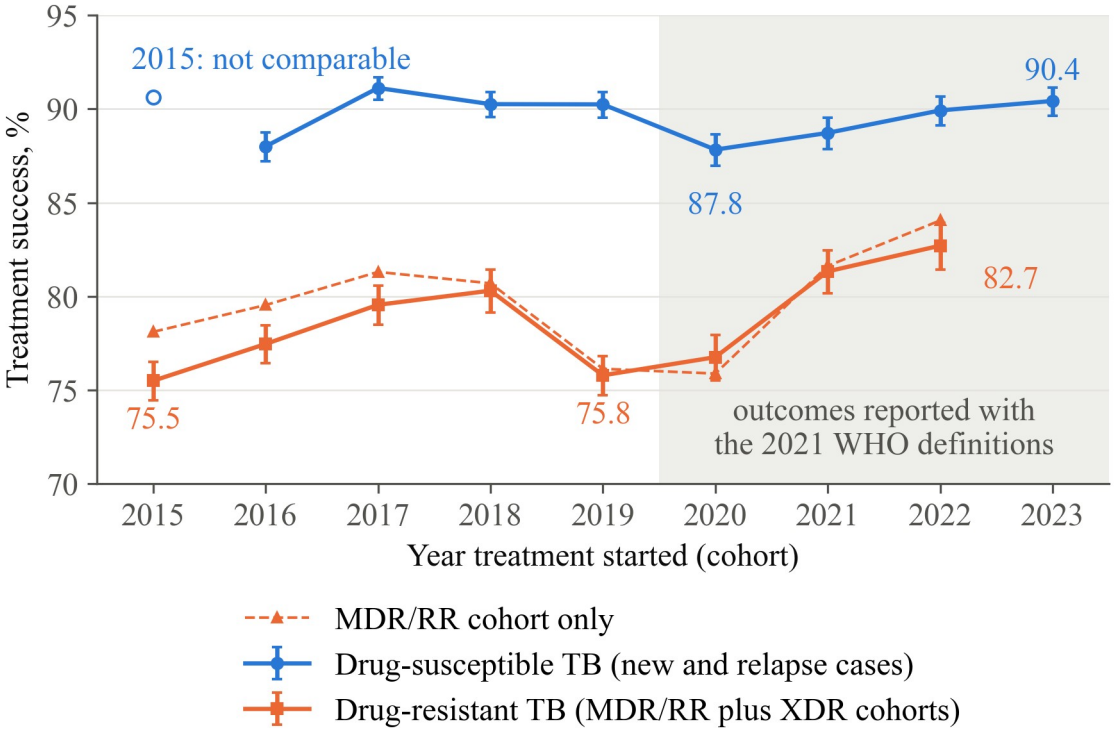


Figure 1. Treatment success by cohort year for drug-susceptible TB (new and relapse cases) and drug-resistant TB (MDR/RR-TB and XDR-TB cohorts together; dashed line: MDR/RR-TB column alone), Kazakhstan, with within-year 95% confidence intervals; the vertical axis starts at 70%. The 2015 drug-susceptible cohort (hollow marker) is not comparable with later years (Section 3). Shaded: cohorts reported with the 2021 WHO outcome definitions. Source: own calculations from [2].

Taken over the comparable cohorts of 2016-2022, success was 89.6% for drug-susceptible TB (47,937 patients) and 78.8% for drug-resistant TB (36,134 patients). The XDR column alone was much worse in the early years (32.2-48.3% success in 2015-2017) and 73-79% from 2018.

4.2 What changed in 2021-2022

The drug-resistant series did not rise steadily. It climbed from 75.5% in 2015 to 80.3% in 2018, fell to 75.8% and 76.8% in 2019 and 2020, and reached its highest values, 81.3% and 82.7%, in 2021 and 2022. The mean of the six earlier yearly rates was 77.6%, with a between-year standard deviation of 2.0 points; the two recent values lie 1.9 and 2.6 standard deviations above it, but both are inside the 95% prediction interval for a new year based on those six cohorts (72.1-83.0%), so they are not clearly outside the earlier variation. Table 2 compares the two most recent cohorts with the two before them; this comparison was chosen after the data were seen and is exploratory.

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Table 2. Outcomes of the 2019-2020 and 2021-2022 cohorts, pooled over the two years.

Outcome, % of cohort	DS-TB 2019-2020	DS-TB 2021-2022	DR-TB 2019-2020	DR-TB 2021-2022	DR-TB change, points
Treatment success	89.2	89.3	76.2	81.9	+5.8 (4.6 to 6.9)
Died	6.8	7.6	11.5	11.2	-0.3 (-1.2 to 0.6)
Treatment failed	2.7	1.7	3.5	2.0	-1.5
Lost to follow-up	1.2	1.1	4.2	3.8	-0.5
Not evaluated	0.1	0.2	4.6	1.1	-3.5
Success among evaluated patients	89.3	89.5	79.9	82.8	+3.0 (1.8 to 4.1)
Patients	13,171	11,543	11,125	7,954	

Note: exploratory comparison; the baseline years were chosen after the data were seen. Changes may differ from the difference of the rounded values by 0.1. Intervals are Newcombe 95% intervals for within-year binomial variation and understate the uncertainty between years. Evaluated patients are all patients except those with no outcome assigned. Source: own calculations from [2].

For drug-resistant TB, success was 5.8 percentage points higher in 2021-2022 than in 2019-2020; for drug-susceptible TB it was practically unchanged (+0.1). Because 2019-2020 were the two weakest recent years, this comparison shows the largest change of any two consecutive earlier years. Against 2017-2018 the rise was 2.1 points, and against all cohorts of 2015-2020 pooled (77.4%) it was 4.6 points. The MDR column alone gives a similar picture (76.0% and 82.6%), but its content shifts between years (Section 3). Compared with the 2020 cohort alone, reported under the same definitions, drug-resistant success was 4.6 points higher in 2021 and 5.9 points higher in 2022; 2020 and 2022 also have the same cohort composition (Section 3).

Most of the rise did not come from fewer deaths. Against 2019-2020, the share with no outcome assigned fell by 3.5 points, treatment failure by 1.5 and loss to follow-up by 0.5, while the share who died hardly changed (11.5% and 11.2%), although it was lower in 2022 alone (9.9%). Against the earlier comparable cohorts, deaths were 1.2 points higher in 2021-2022 among drug-resistant patients (2015-2020) and 1.5 points higher among drug-susceptible patients (2016-2020; 0.8 points against 2019-2020); part of this may come from the 2021 definition of "died", which includes deaths before treatment started. Among patients with an evaluated outcome, success rose by 3.0 points, to 82.8%, which is 2.0-2.7 points above the evaluated values of 2017 and 2018 (80.1% and 80.9%). Treatment failure among drug-resistant patients fell in almost every year, from 7.6% in 2015 to 1.9-2.1% in 2021-2022 (Figure 2a), under a definition that changed in 2020.

4.3 Bedaquiline and shorter regimens

The number of patients who started bedaquiline rose from 227 in 2017 to 830 in 2018, 1,152 in 2019, 1,325 in 2020 and 4,123 in 2021 (Table 3). As a share of all patients who started treatment for drug-resistant TB, this was 4% in 2017, 16-18% in 2018-2019, 25% in 2020 and 89% in 2021 (Figure 2b). Delamanid was reported for 112 patients in 2017 and 385 in 2018, and longer all-oral regimens for 788 patients in 2019, before the jump in bedaquiline, and 3,567 in 2023. Shorter all-oral regimens were reported for 297 patients in 2021, 518 in 2022 and 33 in 2023. The file has no bedaquiline count for 2022.

Table 3. New drugs and regimens for drug-resistant TB in Kazakhstan, 2017-2022.

Year	Started DR-TB treatment	Started bedaquiline	Share on bedaquiline, %	Shorter all-oral regimen	DR-TB success of that cohort, %
2017	6,140	227	3.7	-	79.5
2018	5,200	830	16.0	-	80.3
2019	6,547	1,152	17.6	-	75.8
2020	5,256	1,325	25.2	-	76.8
2021	4,654	4,123	88.6	297	81.3
2022	4,316	not reported	-	518	82.7

Note: started DR-TB treatment includes patients without laboratory confirmation; the outcome cohort includes them only in some years (Section 3). Shorter regimens of other types were

reported for 353 patients in 2018 and 67 in 2019; delamanid for 112 in 2017 and 385 in 2018; longer all-oral regimens for 788 in 2019. Source: own calculations from [2].

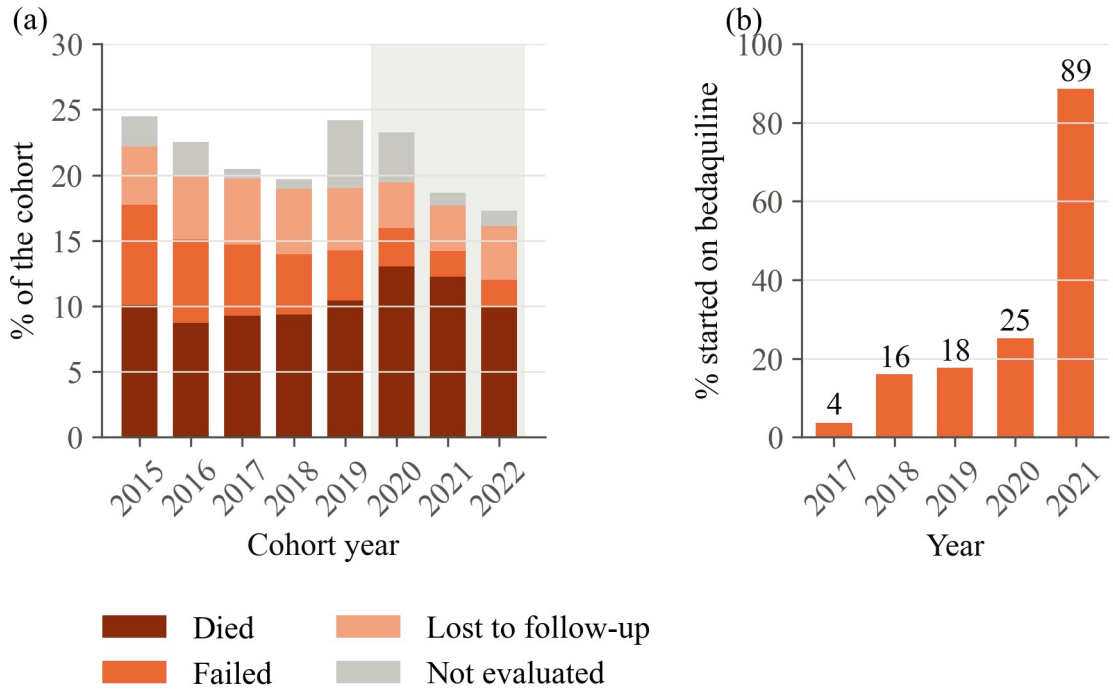


Figure 2. (a) Unsuccessful outcomes of the drug-resistant TB cohorts, % of each cohort (shaded: 2021 WHO outcome definitions; the 2016 and 2019 cohorts include patients without laboratory confirmation); (b) patients started on bedaquiline as a share of all patients who started treatment for drug-resistant TB, including those without laboratory confirmation (no count was reported for 2022), Kazakhstan. The link between the two panels is exploratory. Source: own calculations from [2].

For comparison, the 2022 drug-resistant cohort in Kazakhstan (82.7% success; 84.1% in the MDR column) did better than the pooled 39 countries of the WHO European Region that reported this cohort, Kazakhstan included (65.7%; 67.9% in the MDR column; own calculation from [2]), and better than the world figure for MDR/RR-TB (71%) [1]. The pooled European figure is dominated by the Russian Federation, which accounts for 65% of its patients. Kazakhstan was close to Belarus (82.3%) and Tajikistan (85.3%); Kyrgyzstan had 73.7%, Turkmenistan 69.9% and the Russian Federation 62.1%, and Uzbekistan reported no 2022 cohort [2].

5. Discussion

The first part of the author's hypothesis is supported. In every comparable cohort from 2016 to 2022 people with drug-resistant TB were less likely to finish treatment successfully and more likely to die than people with drug-susceptible TB. This agrees with the registry study of Akhmedullin and co-authors, whose 81.16% success for 2018-2021 is close to the 80.6% success among evaluated patients of the cohorts of the same years here (the registry study covered 12,698 patients, against 20,245 in the WHO cohorts of those years, and excluded patients under 18 and those without a documented outcome) [4]. If fewer drug-resistant patients are cured, drug-resistant TB would be expected to decline more slowly than drug-susceptible TB, which fits the growing drug-resistant share described in Section 1. The data do not show how resistance arose; the high share among previously treated patients fits the idea that interrupted treatment plays a role, but these national figures cannot test it.

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After seeing her mentor's first table and chart of the MDR/RR-TB column (2 November 2026), the author wrote (4 November 2026, translated from Russian): "The graph confirmed my guess that ordinary tuberculosis is easier to cure than resistant tuberculosis. For ordinary tuberculosis the treatment success rate is 88-91%, and for resistant about 76-84%, because the bacteria are resistant to some drugs and treatment becomes more complex and longer. And in 2021-2022 the results for resistant tuberculosis got better because drugs that improve treatment were developed, effective treatment regimens were made, and patients were under supervision." (The ranges are from her mentor's summary of that chart; Figure 1 adds the XDR cohorts.)

The data agree with the timing of this explanation. Bedaquiline and delamanid, approved in 2012 and 2013, were the first new TB drugs in fifty years [11]. Kazakhstan took part in the endTB observational study, which enrolled patients receiving these drugs from April 2015; of 220 patients in Kazakhstan with a positive culture who started them between February 2016 and March 2018, 89% had culture conversion within six months [11]. From September 2020 three 9-month all-oral regimens containing bedaquiline, linezolid and levofloxacin were studied in five public facilities, with 89-100% success [12]; testing for resistance to the new drugs was introduced in 2019-2022 [12]. In the registry study, patients on a short bedaquiline-containing regimen had a much lower risk of an unsuccessful outcome (adjusted relative risk 0.11, 95% CI 0.05-0.27), a result its authors call exploratory because it rests on few events [4]. In the WHO data, the year bedaquiline reached nearly all drug-resistant patients, 2021, is the year success rose. Treatment failure, the outcome that most directly reflects a regimen that does not work, reached its lowest level, but it had been falling every year since 2015, its definition changed in 2020, and longer all-oral regimens were already used for 788 patients in 2019, so the fall cannot be tied to one year or one drug.

Three findings call for caution. First, more than half of the rise came from fewer patients without an outcome, which may reflect better recording rather than better treatment, and deaths did not fall. Second, the 2019-2020 baseline was chosen after seeing the data, and against other baselines the rise is smaller (2.1 points against 2017-2018, 4.6 against 2015-2020). 2019-2020 were also unusual years: the COVID-19 pandemic disrupted TB care, and in Almaty unfavorable outcomes of drug-susceptible TB rose from 11% to 20% during the pandemic [13]; part of the 2021-2022 rise may be a recovery. Drug-susceptible TB is not a good control for this: its treatment lasts about six months, so most of the 2019 cohort finished before the pandemic, while drug-resistant patients who started in 2019 were treated with regimens longer than the 9-month regimens introduced later [12] and were still in treatment in 2020. Recovery from the pandemic and an effect of the new drugs cannot be separated with these data. Third, the drug-resistant categories, the composition of the drug-resistant cohort and the outcome definitions changed between years [8, 9]; adding the two columns and comparing with 2020 reduces, but does not remove, this problem. The idea that patients were better supervised cannot be checked with these data. The safest reading is that the results are consistent with the new drugs having helped, and that the evaluated success of 2021-2022 was only about 2-3 points above the best earlier years.

Several limitations apply. These are national totals: they cannot be adjusted for age, sex, HIV or previous treatment, which are associated with outcomes (age and sex [4, 5]; HIV [4]), and a change in who is treated could change the success rate. The bedaquiline series stops in 2021, and the number of patients on bedaquiline was compared with patients starting treatment in the same year, not followed patient by patient. With eight cohorts the timing can be described but not tested. Finally, the reported figures are those Kazakhstan sent to WHO; they were not checked against the national registry.

6. Conclusion

In Kazakhstan, treatment of drug-resistant TB succeeded in 75.5-82.7% of patients each year from 2015 to 2022, against 87.8-91.1% for drug-susceptible TB, and in every comparable cohort from 2016 to 2022 drug-resistant patients were less often treated successfully and died 1.3-1.9 times as often. This supports the author's view that drug-resistant TB is harder to cure. The gap narrowed in the cohorts of 2021-2022; in 2021, 89% of patients starting treatment for drug-resistant TB were started on bedaquiline (no count was reported for 2022). But much of the improvement came from

fewer patients without a recorded outcome, deaths did not fall, and the size of the rise depends on the baseline chosen after seeing the data, so the role of the new drugs remains a plausible explanation rather than a proven one. The next step would be patient-level registry data that follow who received bedaquiline and shorter regimens, and the 2023 cohort from WHO's 2026 data round.

Data availability

All data are public [2, 6]. Only publicly available aggregate data were used; no individual patient data were accessed, and ethics approval was not required. The analysis script (Python), the downloaded files and the results tables are available from her scientific supervisor on request.

Author contributions and use of AI tools

On 14 October 2026 the author chose the research direction, drug-resistant TB in Kazakhstan, from five directions proposed that day by her first research mentor, Assyltay Sydyk, who had marked it as the one he recommended. In answer to her mentors' questions she wrote the guess and the hypothesis described in Section 2 (16 and 26 October 2026) and the interpretation quoted in Section 5 (4 November 2026). In answer to her supervisor's request to search Google Scholar, she found the studies of Zhandybayeva and co-authors [3] and Akhmedullin and co-authors [4]; she found the second by asking ChatGPT which published studies contained more precise data on the topic, and the supervisor then checked that study against the journal's own page. She confirmed (11 November 2026) that she wrote the passages quoted in Sections 2 and 5 herself, without ChatGPT or any other generative AI tool. She did not do the calculations. Her scientific supervisor, Kurakbay Myrzabek, with a generative AI tool (Claude, Anthropic), downloaded the WHO data, prepared the table and chart she interpreted, defined the research questions and the method, proposed the explanation that drug-susceptible TB declines faster, wrote and ran the analysis code, found the other studies cited and wrote the text in English, including the translation of her words. Every number from the WHO data was computed by code from the WHO files, and the numbers, quotations and references were checked in review rounds by separate AI agents; the author and her supervisor take responsibility for the content.

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Conflicts of interest

The author declares no conflicts of interest. No funding was received.

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