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# Real-World Evidence: The Case of Peru

## Causality between Ivermectin and COVID-19 Infection Fatality Rate

October 2020 / Juan Chamie

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### Introduction

In Peru, the widespread use of Ivermectin as a frontline treatment for COVID-19 has provoked a great deal of controversy. This South American country has been a pivotal point of reference regarding the use of Ivermectin, a repurposed, antiparasitic medication. The Peruvian government approved the use of Ivermectin, by decree, on May 8, 2020. The new Minister of Health, Pilar Mazzetti, ratified the dispensing of Ivermectin, despite receiving numerous requests to suspend it in September, 2020. These measures have aroused criticism among the scientific community. They believe RCTs (Randomized Clinical Trials) are necessary to prove its effectiveness against COVID-19 before distribution, overlooking the serious death toll in Peru, one of the world's highest from COVID-19.

It is important to verify the effect of Ivermectin interventions on the variations in mortality rate and the associated viral lethality. If significant, another assessment is needed to determine if a decrease in the number of new cases is due to a younger infected population, a substantial reduction in the most vulnerable people, or other factors that could explain the variations.

### Methodology

This study evaluated the impact of ivermectin interventions on the excess deaths and the case fatality rate (CFR). It assessed the impact of large distributions of ivermectin, reported by regional authorities, on the variation in death toll associated with COVID-19 in the population over 60 years of age.

The number of deaths associated with COVID-19 were calculated by comparing the numbers to the median number of deaths in the same period for the 3 years prior to COVID-19.

In addition to focusing the assessment on the most vulnerable group, other factors that create variations in mortality were analyzed, such as the number of positive cases in the same age group and the reduction in the population group's size due to the deaths.

This study verified the ivermectin intervention statistics in the Situation Room database, official communications, and press releases that confirmed the drug's effective delivery and actions related to its distribution. It obtained information regarding the mortality and fatality in the selected age group from the registry of the National Computer System of Deaths (SINADEF), and the regional population, by age groups, from the National Institute of Statistics and Informatics.

## Conclusion

In these eight Peruvian State analyses, Ivermectin distributions preceded sound reductions in excess deaths and case fatality rate (CFR). The variation in the number of detected cases nor the vulnerable population decrease can explain this reduction. Other possible explanations, such as cross-immunity with dengue, or mere causality, have been discarded due to their lack of consistency in this study.

Treatment with ivermectin is the most reasonable explanation for the decrease in number of deaths and fatality rate in Peru. Its implementation in public policies is a highly effective measure to reduce the excess deaths and IFR of COVID-19.

## Case 1: State of Loreto

Population: 1,027,559 ; Population over 60 years: 84,137

### Intervention with ivermectin.

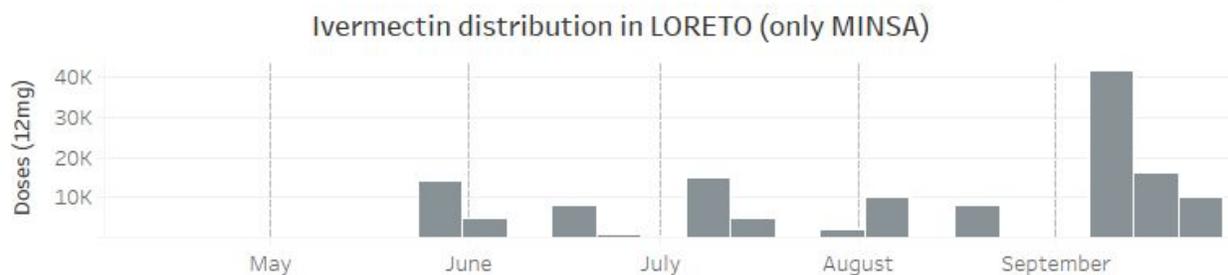
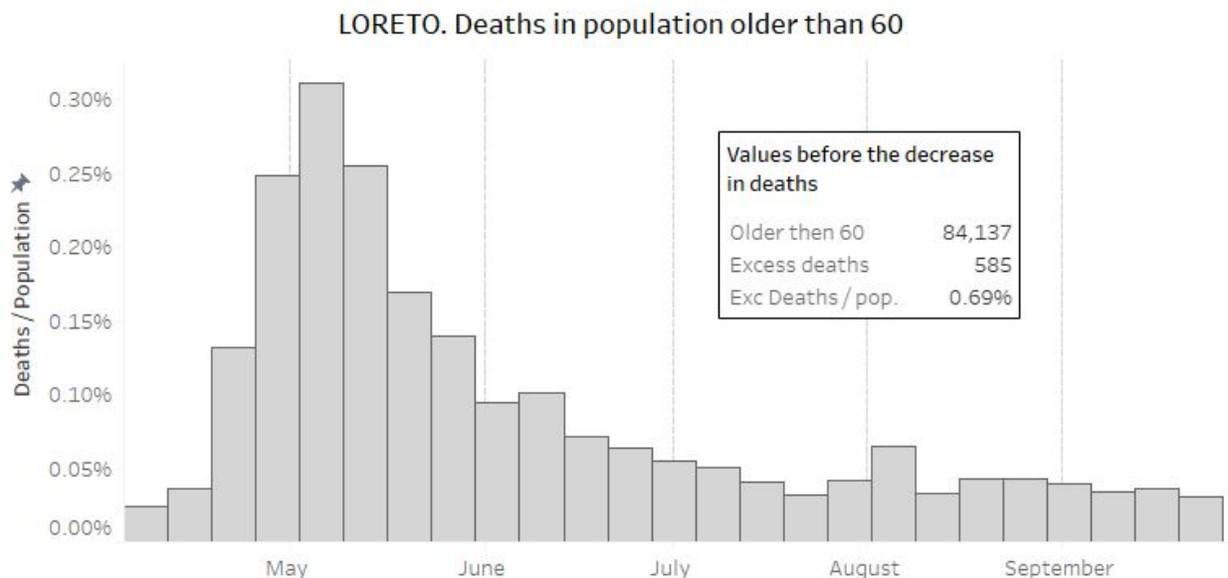
On May 24, the distribution of ivermectin by the Ministry of Health (MINSA) reached 28,545 doses by the end of June, 2020. In July MINSA sent 22,000, in August 18,000, and in September 68,217. MINSA sent a total of 136,762 doses: 0.13 doses per person in the state.

On May 11, 2020, Veterinarian Juan Huamanchumo made his first donation of 3,000 doses of Ivermectin, donating an additional 3,000 doses on May 20. This Ivermectin was received and distributed among the population through the Loreto Medical College.

On May 12, 2020, a group of volunteers, 'Loreto Solidario' began a free campaign to supply doses of Ivermectin to the entire population of Loreto. By June 18, 2020 the group led by Doctor Juan de Mihael vaccinated more than 15,000 adults with Ivermectin.

On May 11, 2020 the director of the Loreto hospital reported a decrease in the number of hospitalizations for COVID. By the end of June, the Regional Health Director closed the Hospital Centre created for the pandemic, due to a lack of patients.

### Results in the population older than 60 years



Source: Datos Abiertos Gobierno de Perú - datosabiertos.gob.pe - Clculations: JuanJChamie@gmail.com @jjchamie

Note, a decrease in deaths from the second week of May. The decrease in fatalities continued until mid-July, and have not increased. Since the beginning of July, the daily number of deaths, in the state of Loreto, is similar to the values presented before the pandemic.

The sharp decrease of deaths happened when only 0.69% of the population in this group had died. The aggregate percentage of deaths from March to September is 1.62%

The case fatality rate was above 40% in April and May. It decreased to 28% in June, and since July has remained below 4%.

Detected COVID-19 positive cases have remained stable between 400 and 500 cases per month, with the exception of August where they increased slightly, reaching 682.

Unexpectedly, the number of excess deaths went from 724 in May to 62 in July, a decrease of 91% in two months. These relative values of deaths went from 0.86% to 0.07%

State of LORETO  
COVID Data from Total Deaths

	Apr	May	Jun	Jul	Aug	Sep
Deaths	319	819	293	157	171	126
Expected deaths	96	96	96	96	96	96
Excess Deaths	224	724	198	62	76	31
Population 60+	84K	84K	84K	84K	84K	84K
Excess deaths / pop	0.27%	0.86%	0.23%	0.07%	0.09%	0.04%

State of LORETO  
COVID Data from tests

	Apr	May	Jun	Jul	Aug	Sep
COVID Cases	209	451	450	454	682	564
COVID Deaths	91	229	124	17	25	14
CFR	44%	51%	28%	4%	4%	2%

Fuente: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe)  
Cálculos: JuanJChamie@gmail.com

The decrease in excess deaths from the second week of May forward coincides with the massive ivermectin interventions. There was no previous decrease in the cases to explain the drop in mortality, nor had there been a significant reduction in the vulnerable population. It had only been reduced by 0.69%.

The sharp decrease in case fatality rate coincided with the distribution of Ivermectin, with an associated decrease in hospital admissions.

## Case 2. State of Ucayali

Population: 589,110; Population over 60 years: 51,639

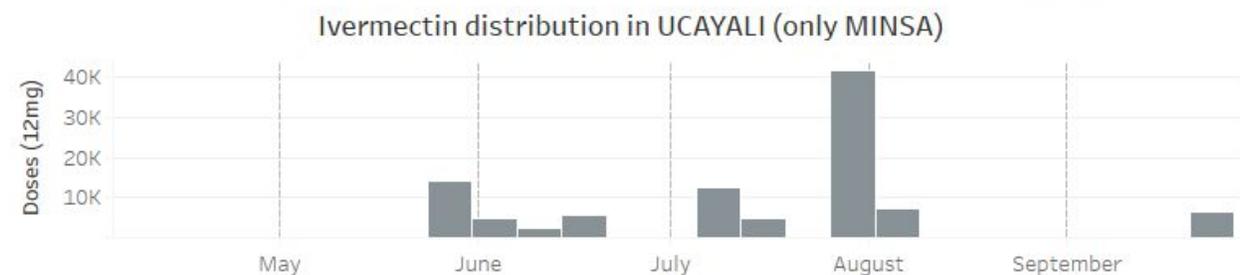
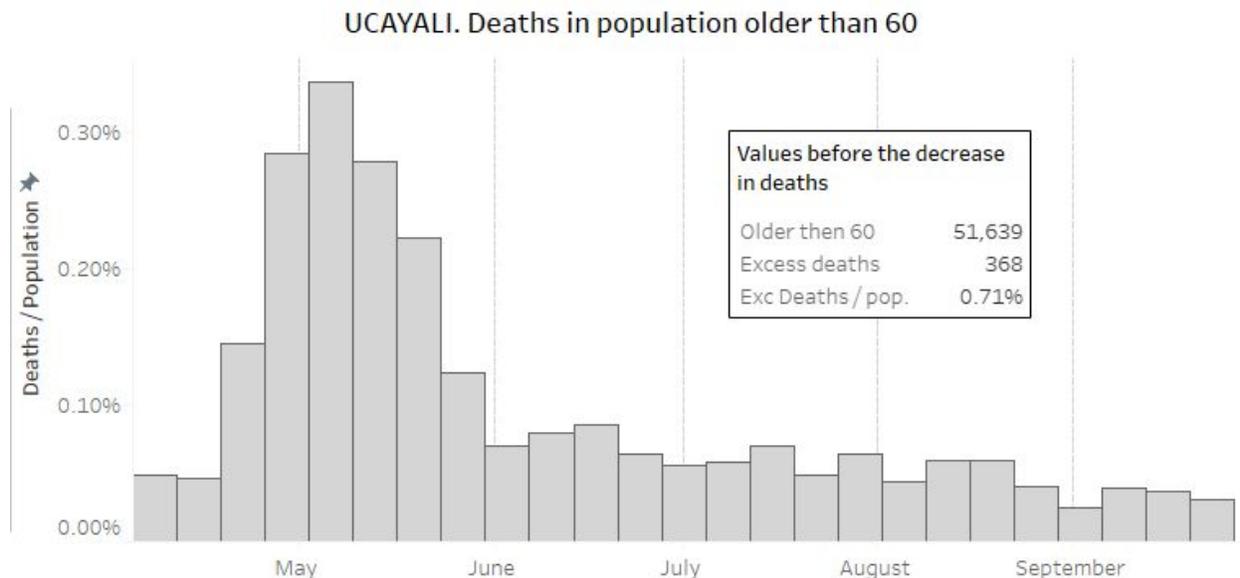
### Intervention with Ivermectin

On May 24, 2020, the distribution of Ivermectin by the Ministry of Health (MINSA) reached 27,390 doses until the end of June. In July MINSA sent 59,167 doses, in August 7,288, and in September 6,300. MINSA sent a total of 100,144 doses: 0.17 doses per person in the state.

On May 7, the general manager at EsSalud, Federico Tong, announced the delivery of ivermectin to be included in the protocol to treat COVID-19.

On May 26, two councilors and an official from the Departmental Government of Ucayali announced the delivery of ivermectin to local authorities and health centers. Raúl Edgar Soto Rivera, one of the counselors, confirmed as of May 18 they had delivered 500 doses of ivermectin and had received a donation of 1,000 additional doses.

On July 7, the director of the Health Directorate of Ucayali, Willy Lora, shared with the media the protocol for the treatment of COVID in that region which included: Azithromycin, Ivermectin drops and Paracetamol.



On June 18, Director of the Ucayali Assistance Network, Dr Francisco Samaniego, announced the start of ivermectin production in the Ucayali region.

### Results in the population older than 60 years

The sharp decrease of deaths happened when only 0.71% of the population in this group had died. The aggregate percentage of deaths from March to September is 1.48%

The case fatality rate, which was above 20% in April, remained below 10% between May and June. Since August it has remained below 3%.

Confirmed Positive COVID-19 cases decreased between May and June, reaching 822 in August, the highest number since the start of the pandemic.

Unexpectedly, excess deaths went from 463 in May to 51 in July, a decrease of 89% in two months. These relative values of deaths went from 0.90% to 0.10%

State of UCAYALI  
COVID Data from Total Deaths

	Apr	May	Jun	Jul	Aug	Sep
Deaths	238	550	162	138	113	73
Expected deaths	88	88	88	88	88	88
Excess Deaths	151	463	75	51	26	-15
Population 60+	52K	52K	52K	52K	52K	52K
Excess deaths / pop	0.29%	0.90%	0.14%	0.10%	0.05%	-0.03%

State of UCAYALI  
COVID Data from tests

	Apr	May	Jun	Jul	Aug	Sep
COVID Cases	114	687	481	477	822	432
COVID Deaths	24	48	44	20	13	11
CFR	21%	7%	9%	4%	2%	3%

Fuente: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe)  
Cálculos: JuanJChamie@gmail.com

Between May and June, the decrease in excess deaths coincided with the distribution of ivermectin. The variation in the number of positive cases is not related to the variation in deaths. There was no significant reduction in this population group to explain why the vulnerable population had only been reduced by 0.71%.

The decrease in the case fatality rate coincides with the start of ivermectin programs.

### Case 3: State of Piura

Population: 2,047,954 ; Population over 60: 234,250

#### Intervention with ivermectin

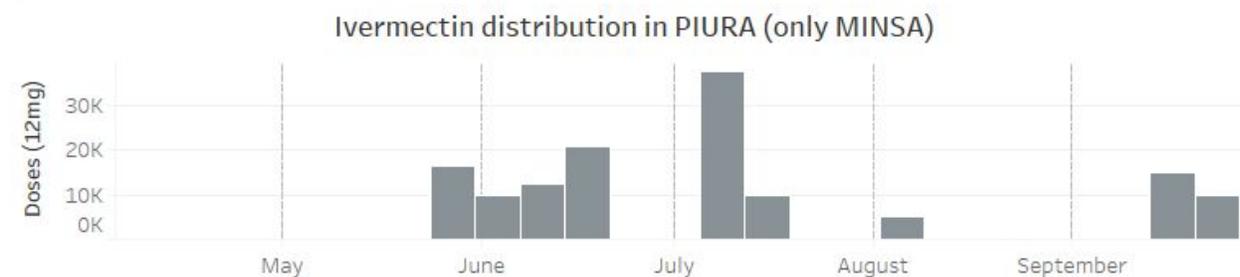
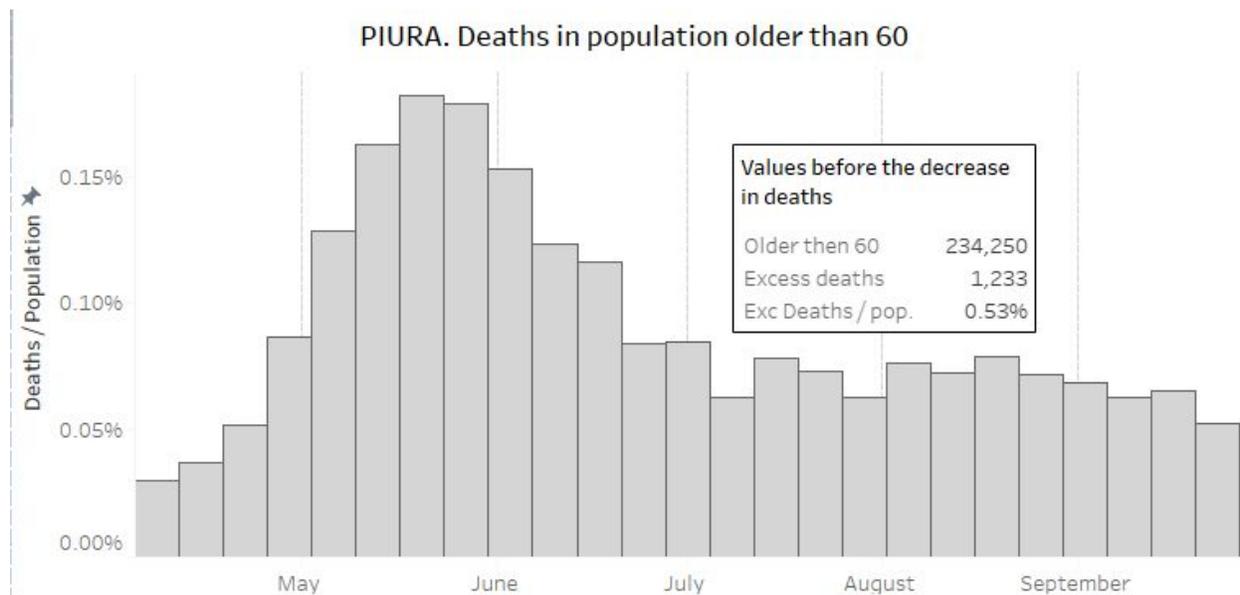
The distribution of ivermectin by the Ministry of Health (MINSA), which began on May 24, 2020, reached 59,590 doses by the end of June. In July, MINSA sent 47,500 doses; in August, 5,000 doses; and in September, 25,000 doses. MINSA sent a total of 137,090 doses, which amounted to 0.07 doses per person in the state.

On May 21, the mayors of the province of Piura announced the purchase of ivermectin to be delivered to the population affected by the virus.

On May 31, a group of volunteers "Comando COVID" reported its campaign to deliver ivermectin, for the treatment of COVID-19, free of charge, to people with limited resources. More than 12,000 doses have been delivered to date.

On July 3, the Piura government announced distribution of 100,000 doses of ivermectin to health centers in the region.

The mayor of Piura, Juan José Díaz Dios, confirmed that by July 22, they had delivered 300,000 doses of ivermectin.



## Results in the population older than 60 years

Beginning the last week of May, there was a decrease in the number of deaths. This decline was steep through the end of June and has continued with a slight decline week after week. The number of daily deaths in Piura has been stable since July, however, it continues to be higher than average before the pandemic.

The decrease of deaths happened when only 0.53% of the population in this group had died. The aggregate percentage of deaths from March to September is 1.41%.

The case fatality rate was around 30% until June. It decreased to 14% in July. Since August it is below 10%.

Monthly, the COVID-19 cases detected have remained stable at approximately 1,400 since May. However, in July there was a decrease in numbers due to a 30% reduction in testing.

Unexpectedly, monthly deaths went from 1,374 in May to 387 in July. A decrease of 72% in two months. The relative values of deaths went from 0.59% to 0.17% for this population group.

State of PIURA  
COVID Data from Total Deaths

	Apr	May	Jun	Jul	Aug	Sep
Deaths	486	1,727	1,159	740	789	627
Expected deaths	353	353	353	353	353	353
Excess Deaths	133	1,374	806	387	436	274
Population 60+	234K	234K	234K	234K	234K	234K
Excess deaths/pop	0.06%	0.59%	0.34%	0.17%	0.19%	0.12%

State of PIURA  
COVID Data from tests

	Apr	May	Jun	Jul	Aug	Sep
COVID Cases	478	1,482	1,400	848	1,409	1,037
COVID Deaths	123	418	491	112	129	91
CFR	26%	28%	35%	13%	9%	9%

Fuente: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe)  
Cálculos: JuanJChamie@gmail.com

The decrease in the excess deaths at the end of May coincides with the distribution of ivermectin in the department. The variation in the number of positive cases does not explain the variation in deaths, nor can it be explained by a substantial reduction in this population group, which had only decreased 0.53%.

The reduction in the case fatality rate that occurred as of July also coincides with the distribution of ivermectin in the Department's Health Centers.

### Case 4: State of Tumbes

Population: 251,521 ; Population over 60: 28,166

#### Intervention with ivermectin

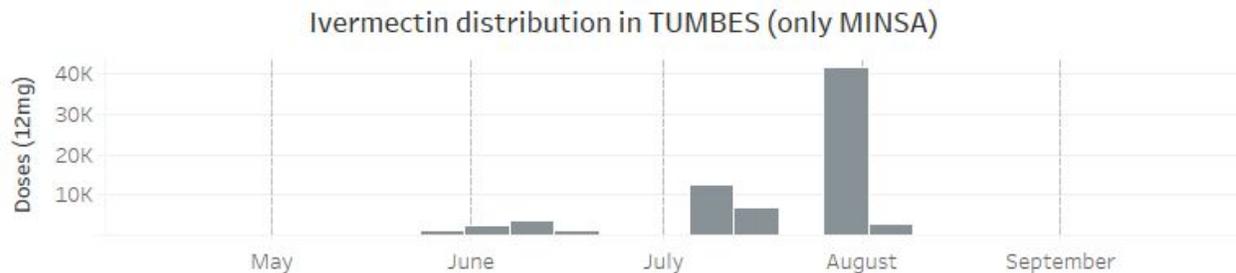
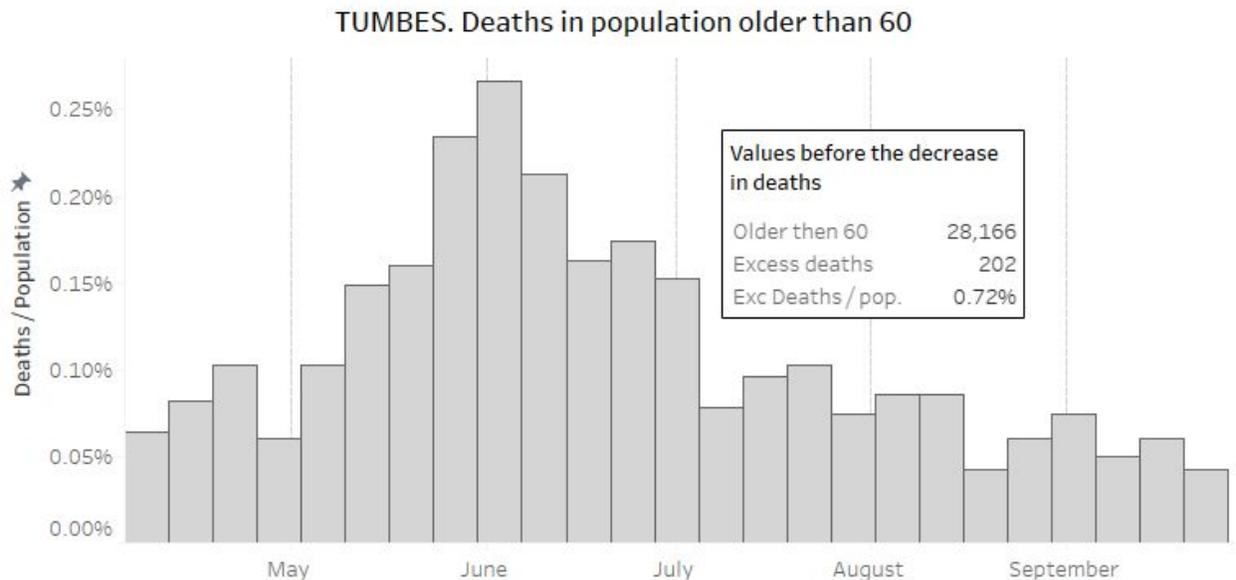
The distribution of ivermectin by the Ministry of Health (MINSA) that began on May 24, 2020 reached 9,795 doses through June 14. In July MINSA sent 61,167 doses, and in August 3,000. MINSA sent a total of 72,962 doses, amounting to 0.29 doses per person in the state.

June 9, the Governor of the Department and the Director of Health of the region announced that they have promoted the active search for COVID-19 patients who are given ivermectin as part of the treatment.

June 27, The Governor of Tumbes, in a meeting with the Mayors of the Region, announced the implementation of the "Pharmacological Blockade" program in all the Districts of the Department, with an associated acquisition of 50 thousand doses of ivermectin.

#### Results in the population older than 60 years

In the first week of June, the number of deaths began to decline, with a further decline in the first week of August. The drop in fatalities continued week after week. The daily number of deaths in Tumbes since mid-August is similar to the average number before the pandemic.



Source: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe) - Clculations: JuanJChamie@gmail.com @jjchamie

The decrease in the number of deaths occurred when 0.72% of this population group had died. The aggregate percentage of deaths from March to September is 1.86%.

The fatality rate, which remained around 30% until June, decreased to 6% in July and 3% in August.

COVID-19 cases from May to August have remained stable at between 180 and 315 cases.

Unexpected excess deaths went from 198 in June to 38 in August, a decrease of 81% in two months. The relative values of deaths went from 0.70% to 0.13% in this population group.

State of TUMBES  
COVID Data from Total Deaths

	Apr	May	Jun	Jul	Aug	Sep
Deaths	90	200	247	110	87	68
Expected deaths	49	49	49	49	49	49
Excess Deaths	41	151	198	61	38	19
Population 60+	28K	28K	28K	28K	28K	28K
Excess deaths / pop	0.15%	0.54%	0.70%	0.22%	0.13%	0.07%

State of TUMBES  
COVID Data from tests

	Apr	May	Jun	Jul	Aug	Sep
COVID Cases	75	219	313	191	274	200
COVID Deaths	21	70	92	11	9	16
CFR	28%	32%	29%	6%	3%	8%

Fuente: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe)  
Cálculos: JuanJChamie@gmail.com

The decrease in deaths that occurred from June coincides with the beginning of the distribution of ivermectin in the department. The variation in the number of positive cases does not explain the variation in deaths, nor can it be explained by a substantial reduction in this population group, which had only been reduced by 0.72%.

The reduction in the case fatality rate as of July coincides with the expansion of the "Pharmacological Blockade" program where the central axis is ivermectin, throughout the state.

## Case 5: State of La Libertad

Population: 2,016,771; Population over 60: 257,655

### Intervention with ivermectin

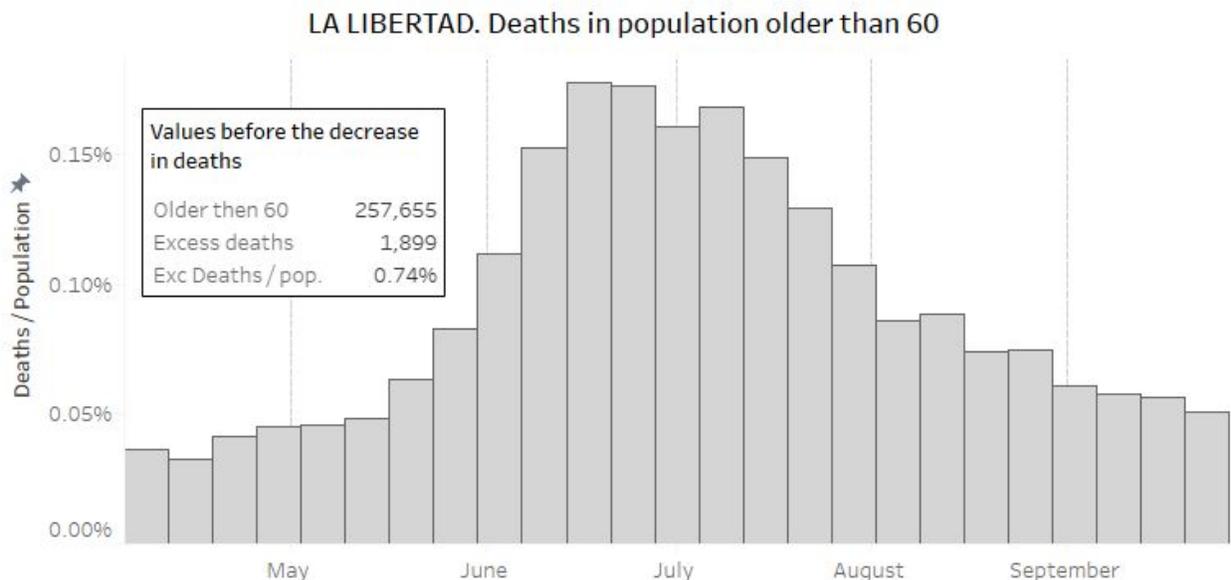
The distribution of ivermectin by the Ministry of Health (MINSA) that began on May 24, 2020 reached 42,355 doses through the end of June. In July MINSA sent 154,000 doses, in August 98,333, and in September 35,750. MINSA sent a total of 330,438 doses: 0.16 doses per person in the state.

On July 23, the regional governor of La Libertad, Manuel Llempén reported he had distributed 40,000 doses of ivermectin among health centers in the region.

On July 20, the Government of La Libertad reported delivery of ivermectin to more than 30,000 people, including patients with COVID-19 and their families.

On August 4, the La Libertad Medical College requested termination of the ivermectin mass distribution program, arguing that it generated false hopes. They also stated that deaths had not been reduced. In an official communication on June 15, the regional entity had already rejected the use of ivermectin and had recommended abstaining from its use.

### Results in the population older than 60 years



Source: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe) - Clculations: [JuanJChamie@gmail.com](mailto:JuanJChamie@gmail.com) @jjchamie

In the second week of June, the number of deaths had slowed, and from the second week of July they began to decline. The decline in fatalities has continued week after week. The deaths in La Libertad since the second week of September are similar to the values presented before the pandemic.

The decrease in the number of deaths occurred when only 0.74% of this population group had died. The aggregate percentage of deaths from March to September is 1.27%.

The fatality rate, which grew month by month until reaching 60% in June, rose to 25% in July, in August it was 13%, and in September 9.5%.

COVID-19 cases detected between June and August have increased slightly from 1,204 cases in June to 1,394 in August. In September decreased to 1,155.

Unexpectedly, excess deaths went from 1,293 in June to 485 in August. A 62% decrease in two months. Between the same period, the relative values of deaths went from 0.50% to 0.19% in this population group.

State of LA LIBERTAD  
COVID Data from Total Deaths

	Apr	May	Jun	Jul	Aug	Sep
Deaths	416	702	1,754	1,640	946	617
Expected deaths	462	462	462	462	462	462
Excess Deaths	-46	241	1,293	1,179	485	156
Population 60+	258K	258K	258K	258K	258K	258K
Excess deaths / pop	-0.02%	0.09%	0.50%	0.46%	0.19%	0.06%

State of LA LIBERTAD  
COVID Data from tests

	Apr	May	Jun	Jul	Aug	Sep
COVID Cases	170	643	1,204	1,220	1,394	1,155
COVID Deaths	37	208	713	302	184	110
CFR	22%	32%	59%	25%	13%	10%

Fuente: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe)  
Cálculos: JuanJChamie@gmail.com

By the end of June, the decrease in deaths coincides with the distribution of ivermectin in the department. The variation in the number of positive cases does not explain the variation in deaths, nor can it be explained by a substantial reduction in this population group, which had only been reduced by 0.74%.

The reduction in the case fatality rate began to appear in mid-June and coincided with the distribution of ivermectin in the department's health centers. The fatality rate is higher than that shown in other states. It is important to verify whether this higher fatality has been a consequence of the regional medical college's rejection of ivermectin treatment.

## Case 6: State of Arequipa

Population: 1,497,438 ; Population over 60: 212,228

### Intervention with ivermectin

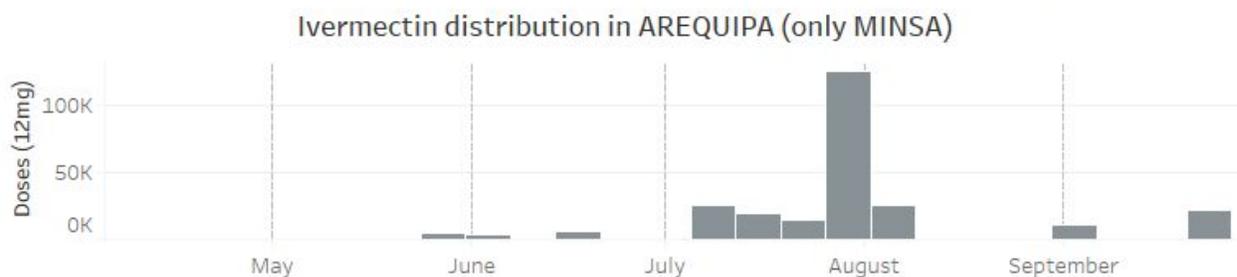
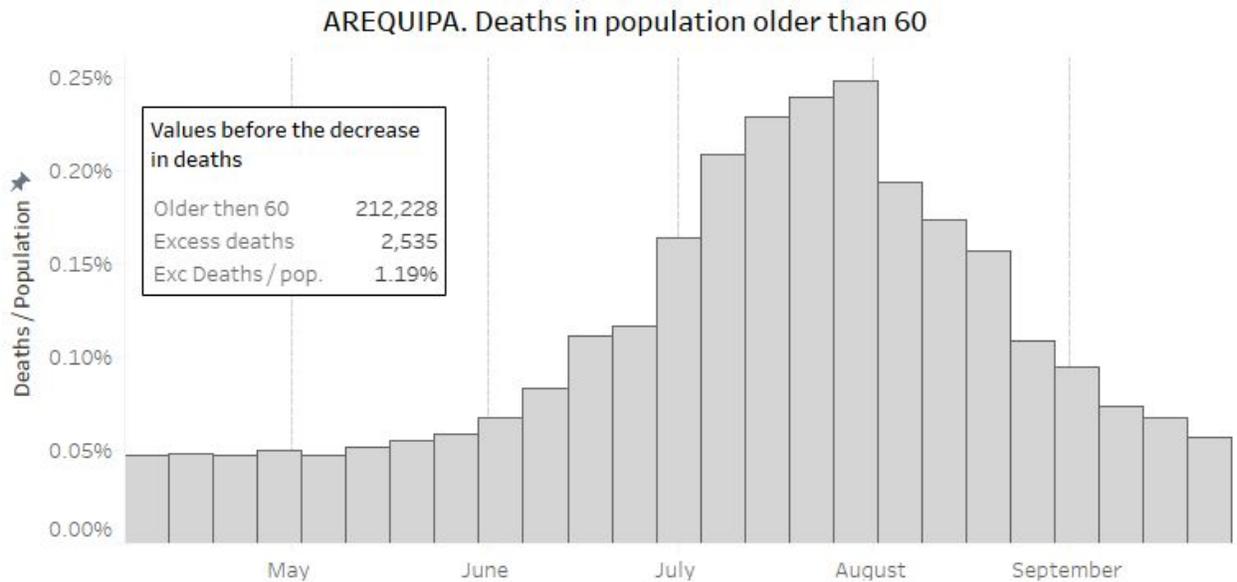
The distribution of Ivermectin by the Ministry of Health (MINSA) that began on May 24, 2020 reached 15,375 doses through the end of June. In July MINSA sent 185,000 doses, in August 25,000, and in September 33,000. MINSA sent a total of 258,375 doses, which amounted to 0.17 doses per person in the state.

On July 20, the Arequipa Health Network (La Red de Salud Arequipa) began delivery of ivermectin to the population affected by the virus in its initial stage

On July 20, the 25 regional health centers began to deliver ivermectin, azithromycin and Acetaminophen to all diagnosed patients.

On August 5, in an emergency meeting, the mayors of Arequipa agreed to manage the purchase of one million doses of ivermectin for the treatment of patients infected by the coronavirus.

### Results in the population older than 60 years



In the first week of August, the number of deaths plummeted. It followed a steady decline in fatalities that has continued week after week. The deaths in La Arequipa at the end of September are similar to values presented before the pandemic.

The decrease in the number of deaths occurred when only 1.19% of this population group had died. The aggregate percentage of deaths from March to September is 1.79%.

The case fatality rate, which grew month by month until reaching 20% in July. Since August it is below 10%.

Detected COVID-19 cases grew exponentially from 346 cases in June to 3,447 in August. In September cases decreased to 1,532 due less testing.

Unexpected excess deaths went from 1,728 in July to 243 in September, a 86% decrease in two months. Between the same period, the relative values of deaths went from 0.86% to 0.16% in this population group.

State of AREQUIPA  
COVID Data from Total Deaths

	Apr	May	Jun	Jul	Aug	Sep
Deaths	441	504	914	2,112	1,477	627
Expected deaths	384	384	384	384	384	384
Excess Deaths	57	120	530	1,728	1,093	243
Population 60+	212K	212K	212K	212K	212K	212K
Excess deaths / pop	0.03%	0.06%	0.25%	0.81%	0.52%	0.11%

State of AREQUIPA  
COVID Data from tests

	Apr	May	Jun	Jul	Aug	Sep
COVID Cases	107	346	948	1,859	3,447	1,532
COVID Deaths	9	36	150	366	302	146
CFR	8%	10%	16%	20%	9%	10%

Fuente: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe)  
Cálculos: JuanJChamie@gmail.com

The decrease in deaths that occurred from August coincides with the massive ivermectin distribution program in the department. The variation in the number of positive cases does not explain the variation in deaths, nor can it be explained by a substantial reduction in this population group, which had only been reduced by 1.19%.

The reduction in the case fatality rate began to appear in August and coincided with the distribution of ivermectin in the department's health centers.

## Case 7: State of Moquegua

Population: 192,740 ; Population over 60: 29,157

### Intervention with ivermectin

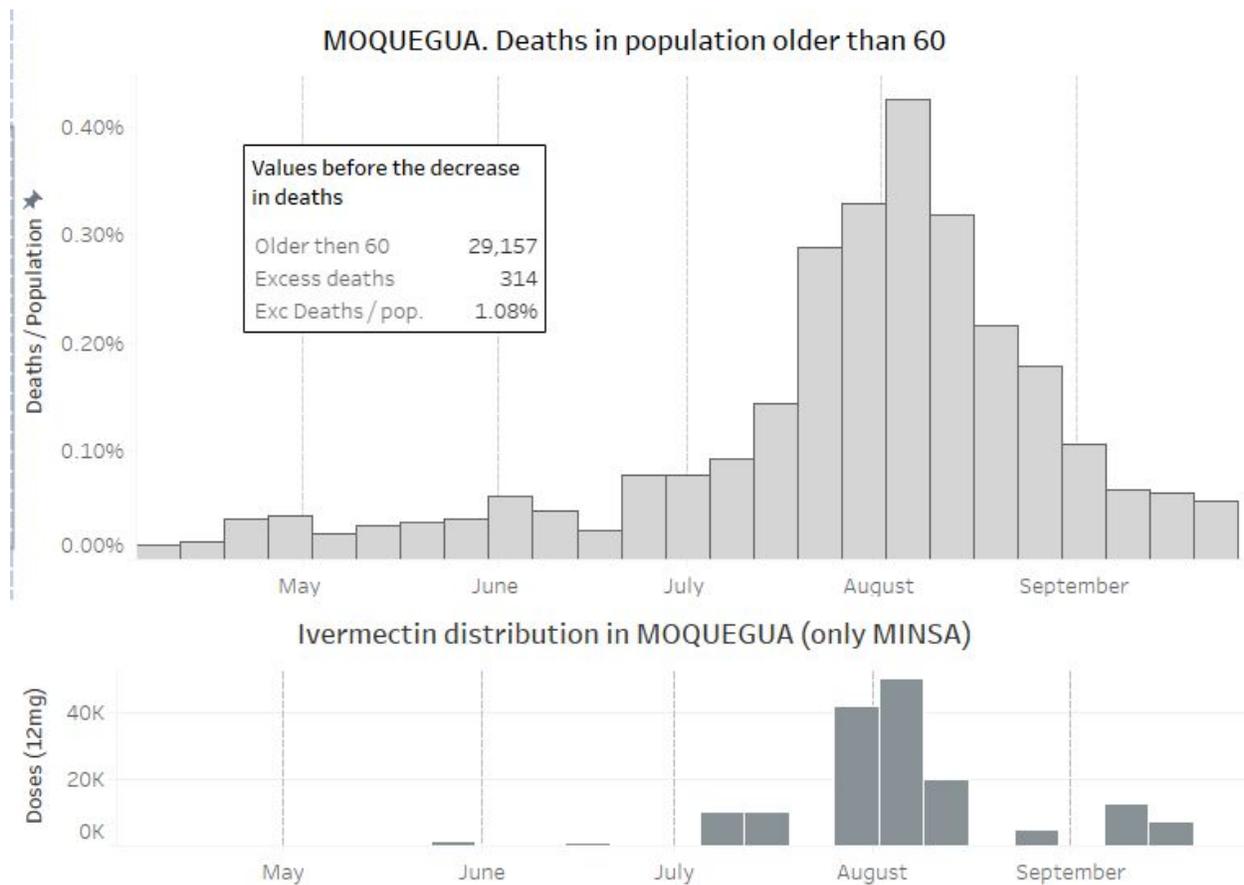
The distribution of ivermectin by the Ministry of Health (MINSA) that began on May 24, 2020 reached 2,605 doses through the end of June. Between July 5 and 12, MINSA sent 20,000 doses; between July 26 and August 9, 116,667 doses; and on August 23, 25,000 doses. MINSA sent a total of 159,322 doses, which amounted to 0.83 doses per person in the state.

On July 10, the Moquegua Regional Hospital began the production of ivermectin. The drug would be sent to health centers for the treatment of patients with COVID-19.

The Moquegua region received medical personnel and a large shipment of medicines on August 5, with the purpose of starting its massive distribution as of August 6 as part of the government program called "Operation Tayta."

According to the official medicine distribution records of the Ministry of Health, between August 4 and 13, the national government distributed 28,000 doses of ivermectin in Moquegua.

On August 15, the Moquegua Development Fund delivered two thousand kits with Paracetamol, Azithromycin and Ivermectin.



## Results in the population older than 60 years

Starting the first week of August, the number of deaths began to plummet. The decline in fatalities has continued week after week. The deaths in Moquegua in September are similar to those that occurred before the pandemic.

The decrease in the number of deaths occurred when 1.08% of this population group died. The aggregate percentage of deaths from March to September is 1.76%.

The case fatality rate, which grew month by month reached 32% in June. It declined to 15% in July, 8% in August and 4% in September.

Detected COVID-19 cases grew exponentially from 60 cases in June to 1,047 in August. In September cases dropped following a decrease in testing.

Unexpectedly, excess deaths went from 309 in August to 29 in September, a decrease of 91% in one month. The relative values of deaths went from 1.06% to 0.10% of this population group.

State of MOQUEGUA  
COVID Data from Total Deaths

	Apr	May	Jun	Jul	Aug	Sep
Deaths	31	41	69	249	360	80
Expected deaths	51	51	51	51	51	51
Excess Deaths	-20	-10	18	198	309	29
Population 60+	29K	29K	29K	29K	29K	29K
Excess deaths / pop	-0.07%	-0.03%	0.06%	0.68%	1.06%	0.10%

State of MOQUEGUA  
COVID Data from tests

	Apr	May	Jun	Jul	Aug	Sep
COVID Cases	18	99	60	437	1,047	600
COVID Deaths	1	5	19	65	79	26
CFR	6%	5%	32%	15%	8%	4%

Fuente: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe)  
Cálculos: JuanJChamie@gmail.com

The decrease in deaths from August coincides with the massive ivermectin distribution program in the department. The variation in the number of positive cases does not explain the variation in deaths, nor can it be explained by a substantial reduction in this population group, which had only been reduced by 1.08%.

The reduction in the case fatality rate from July coincides with the production of ivermectin at the regional hospital, and the other drug delivery campaigns.

## Case 8: State of Cusco

Population: 1,357,075 ; Population over 60: 138,969

### Intervention with ivermectin

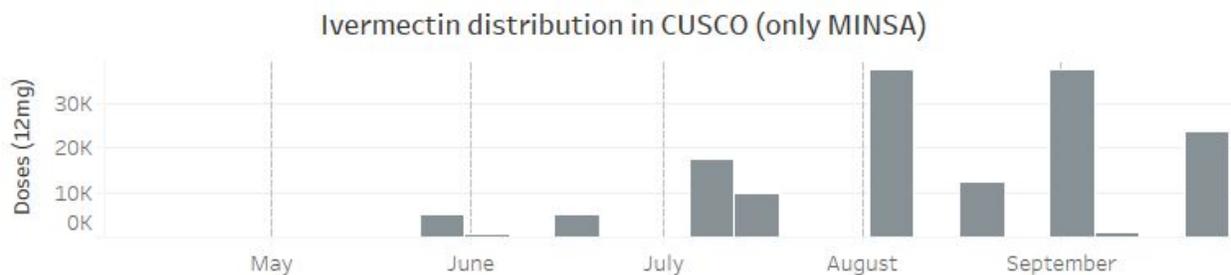
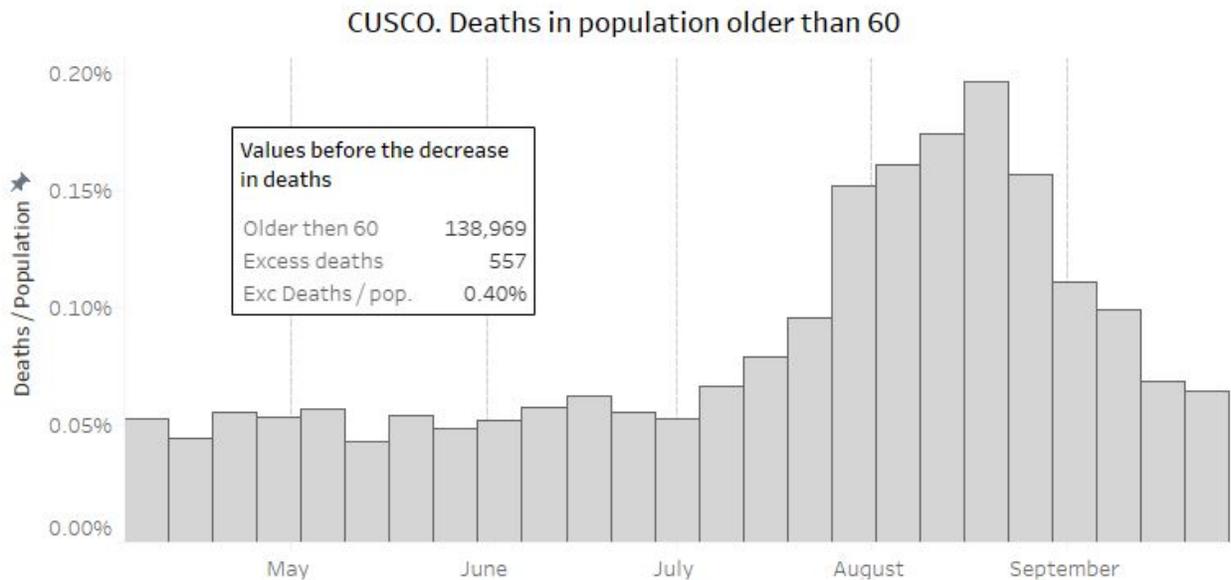
The distribution of ivermectin by the Ministry of Health (MINSA) that began on May 24, 2020 reached 10,828 doses through the end of June. In July MINSA sent 27,500 doses; in August, 50,000 doses; and in September, 62,375 doses. MINSA sent a total of 150,703 doses, which amounted to 0.11 doses per each person in the state.

On June 15, the Adolfo Guevara Velasco National Hospital in Cusco received new medical equipment and 600 doses of ivermectin for the treatment of COVID patients.

On August 15, 2020, the Cusco Health Directorate began the distribution of ivermectin among health centers in the region. One thousand daily doses was its initial production capacity.

On August 20, the regional director of Health in Cusco announced the distribution of 20,000 ivermectin treatments.

### Results in the population older than 60 years



Source: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe) - Clculations: [JuanJChamie@gmail.com](mailto:JuanJChamie@gmail.com) @jjchamie

In the last week of August, the number of deaths began to drop dramatically. Fatalities decreased week after week. The daily number of deaths in Cusco in the second week of September is similar to the average number before the pandemic.

The decrease in the number of deaths occurred when only 0.40% of this population group had died. The aggregate percentage of deaths from March to September is 0.66%.

By June, the cumulative fatality rate was 16%. During July and August, the fatality rate had been below 10%.

Detected COVID-19 cases grew exponentially, moving from 71 cases in June to 1,679 in August. In September cases dropped following a decrease in testing.

Unexpectedly, excess deaths went from 725 in August to 165 in September. A decrease of 77% in one month. The relative values of deaths went from 0.52% to 0.12% of this population group.

**State of CUSCO**  
COVID Data from Total Deaths

	Apr	May	Jun	Jul	Aug	Sep
Deaths	309	317	341	554	1,063	503
Expected deaths	339	339	339	339	339	339
Excess Deaths	-30	-22	3	216	725	165
Population 60+	139K	139K	139K	139K	139K	139K
Excess deaths / pop	-0.02%	-0.02%	0.00%	0.16%	0.52%	0.12%

**State of CUSCO**  
COVID Data from tests

	Apr	May	Jun	Jul	Aug	Sep
COVID Cases	8	86	71	496	1,679	742
COVID Deaths	2	3	20	45	156	73
CFR	25%	3%	28%	9%	9%	10%

Fuente: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe)  
Cálculos: JuanJChamie@gmail.com

The decrease in deaths at the end of August coincided with the distribution of ivermectin in the department. The variation in the number of positive cases does not explain the variation in deaths, nor can it be explained by a substantial reduction in this population group, which had only decreased by 0.40%.

The reduction in the case fatality rate began in July and coincides with the distribution of ivermectin by the Ministry of Health.

## Control group: State of Lima

Population: 10,628,470 ; Population over 60: 1,648,028

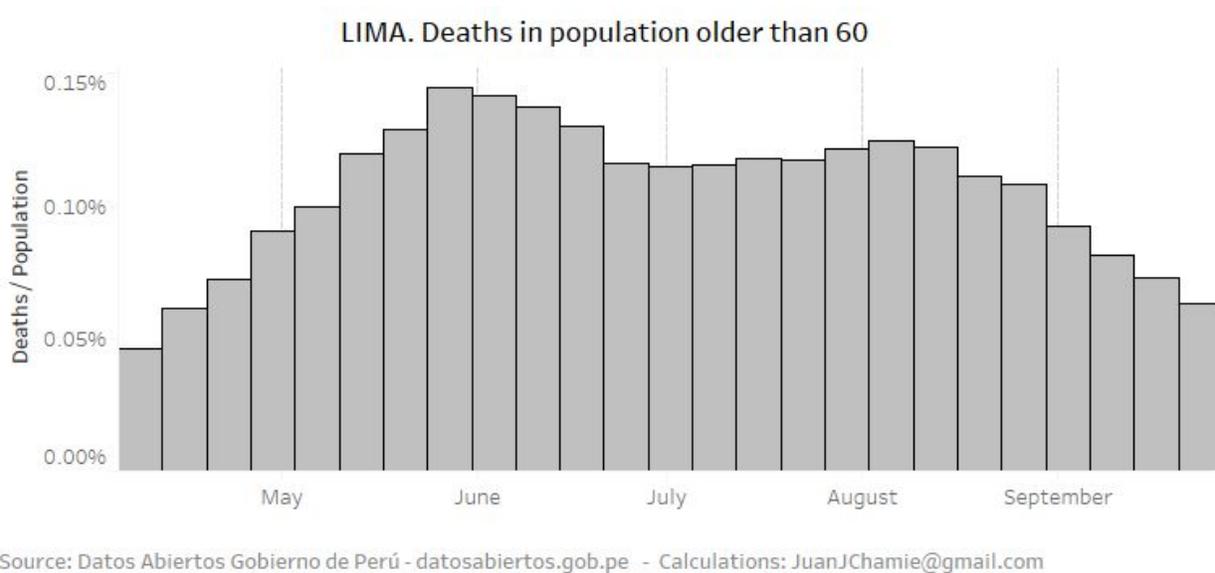
### Intervention with ivermectin

The distribution of ivermectin by the Ministry of Health (MINSA) that began on June 1, 2020 only reached 4,066 patients by mid-July.

On August 20, 2020 the Ministry of Defense announced the 'Mega Tayta Operation,' its goal being to reach 500,000 COVID-positive patients by the end of the year. Lima was included in the program.

A recent Peruvian observational study showed that less than 10% (561) of Covid-positive hospitalized patients in Lima received ivermectin as a treatment from April to July, out of a sample of 5,683 patients.

### Results in the population older than 60 years



During the first week of June, the number of deaths shortly dropped, then fatalities plateaued until mid August. In September, the daily number of deaths in Lima was higher than any other state of Peru.

The decrease in the number of deaths took place when 1.82% of the population group had died. The aggregate percentage of deaths from March to September was 2.02%.

The case fatality rate, which stayed around 20% from April to July declined in August, but it still remains the highest among Peruvian States.

Detected COVID-19 cases remained stable at around 10,000 cases since April. In August cases grew, following an increase in testing.

The deaths in the Lima districts showed the same growth in April and the same plateau from June. Lima showed a unified single wave.

**State of LIMA**  
**COVID Data from Total Deaths**

	Apr	May	Jun	Jul	Aug	Sep
Deaths	4,384	8,897	9,205	8,558	8,413	5,225
Expected deaths	2,204	2,204	2,204	2,204	2,204	2,204
Excess Deaths	2,180	6,693	7,001	6,354	6,209	3,021
Population 60+	1,648K	1,648K	1,648K	1,648K	1,648K	1,648K
Excess deaths / pop	0.13%	0.41%	0.42%	0.39%	0.38%	0.18%

**State of LIMA**  
**COVID Data from tests**

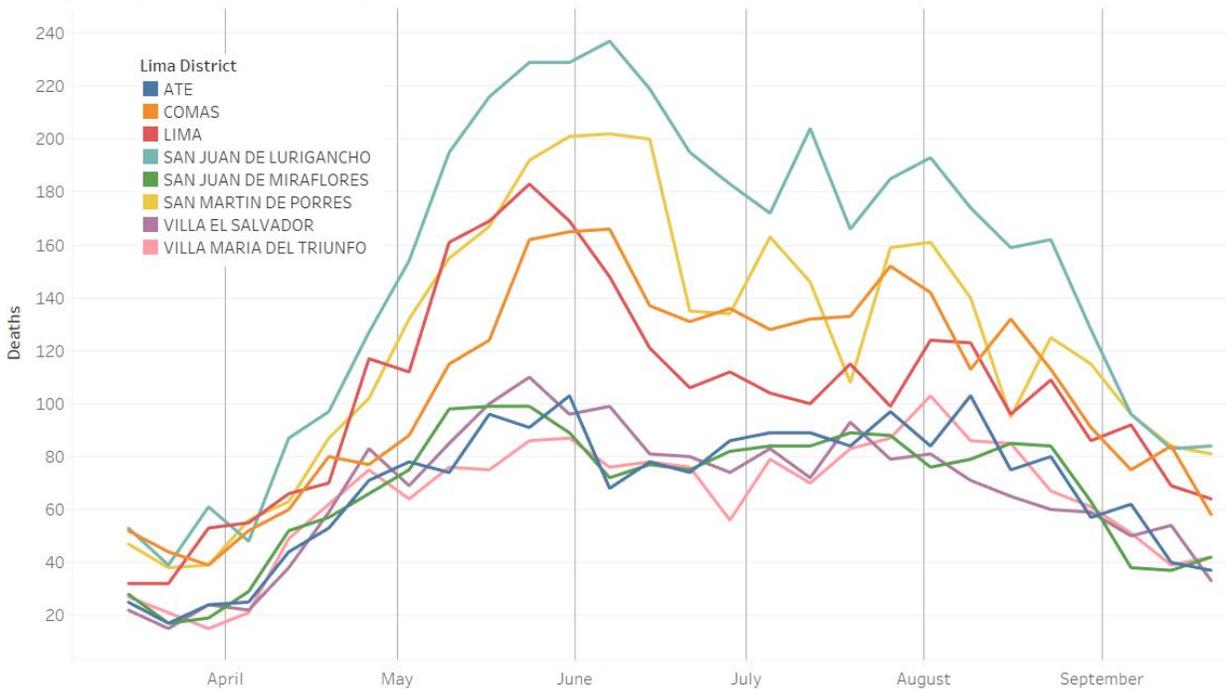
	Apr	May	Jun	Jul	Aug	Sep
COVID Cases	4,767	11,922	10,278	10,500	15,665	9,271
COVID Deaths	965	2,247	2,114	1,751	1,777	1,262
CFR	20%	19%	21%	17%	11%	14%

Fuente: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe)  
 Cálculos: JuanJChamie@gmail.com

Excess deaths remained stable between 6,000 and 7,000 from April to August. There was a 50% decrease in September. The relative values of deaths were around 0.40% of this population group.

There was no decrease in deaths between April and August, nor reduction in the case fatality rate during this period.

**Total Deaths**  
**Lima (Most populated districts)**



Source: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe) - Calculations: JuanJChamie@gmail.com

## Discussion

The correlation between the ivermectin interventions and the decrease in both excess deaths and case fatality rate are quite strong and consistent in all the regions analyzed. Because the correlation is strong, the probability of this being caused by other factors is low.

The most certain way to rule out a correlation occurring by random chance is to find the same correlation in several cases. This study has seen the correlation between interventions with ivermectin and a decrease in excess deaths and the case fatality rate in eight Peruvian states. Additionally, when analyzing two outcomes instead of one (excess deaths and CFR), a casual result becomes even more implausible. In this manner, we discard accidental cause as an explanation for the correlation.

Regarding external factors, we have already ruled out causality by a higher percentage of the young population by including only people over 60 years of age in the study. We also ruled out the variation in the number of cases when verifying that there was no decrease in these before reducing mortality. We also ruled out a substantial reduction in the susceptible population when confirming that in no case did deaths reduce this population by more than 2.0%.

Regarding susceptible population reduction at the time of the decrease in excess deaths and CFR, these values were unequal in the states analyzed. As an example, the population reduction in Arequipa was four times higher than the decrease in Cusco.

To rule out the possibility of a weaker strain of the virus having mutated throughout the Peruvian region, thereby conveying some degree of cross-immunity to COVID-19, Lima has been included in the study as a control group. The excess deaths and CFT in the Peruvian Capital remained stable for five months, between April and August.

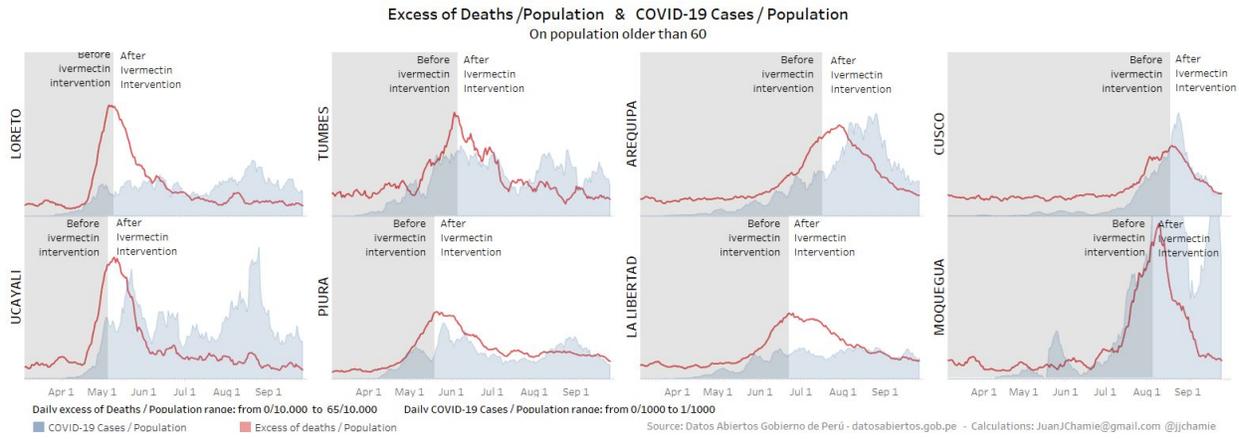
Recently, a new theory emerged that some scientists say could explain the low mortality levels in some regions. It is a cross-immunity with dengue that would explain the low levels of mortality. This theory collapses here, by observing the high mortality rates in Peruvian states such as Arequipa and Moquegua, where there haven't been dengue cases in the last 20 years. The mortality rose with COVID cases and dropped after the intervention with ivermectin.

## Conclusion

In these eight Peruvian State analyses, ivermectin distributions preceded significant reductions in number of deaths and infection fatality rate. The variation in the number of detected cases or a decrease in the vulnerable population can't explain the mortality and lethality improvement. Likewise, other possible explanations, such as crossed immunity with dengue, or mere causality, have been discarded here due to their lack of consistency.

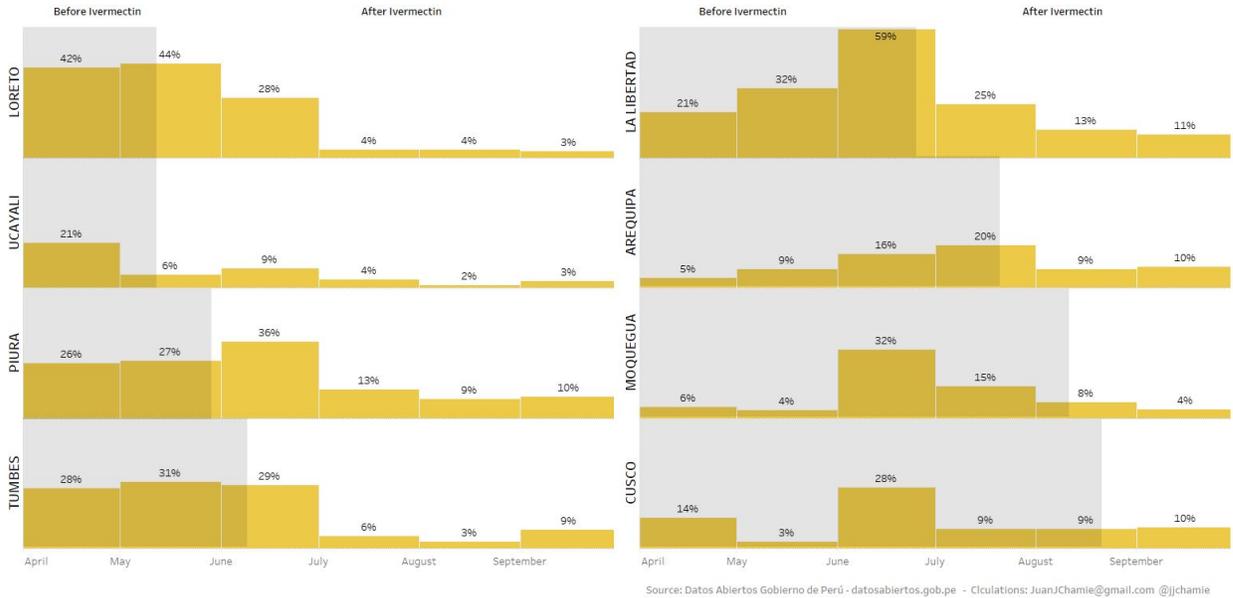
Treatment with Ivermectin is the most reasonable explanation for the decrease in the death and fatality rate in Peru. Its implementation in public policy is a highly effective measure to reduce the mortality and lethality of COVID-19.

## Charts and tables



## IFR (Infection Fatality Rate)

On population older than 60



## Cases, deaths and CFR

Data from test results

		Apr	May	Jun	Jul	Aug	Sep
LORETO	COVID Cases	209	451	450	454	682	564
	COVID Deaths	91	229	124	17	25	14
	CFR	43.5%	50.8%	27.6%	3.7%	3.7%	2.5%
UCAYALI	COVID Cases	114	687	481	477	822	432
	COVID Deaths	24	48	44	20	13	11
	CFR	21.1%	7.0%	9.1%	4.2%	1.6%	2.5%
PIURA	COVID Cases	478	1,482	1,400	848	1,409	1,037
	COVID Deaths	123	418	491	112	129	91
	CFR	25.7%	28.2%	35.1%	13.2%	9.2%	8.8%
TUMBES	COVID Cases	75	219	313	191	274	200
	COVID Deaths	21	70	92	11	9	16
	CFR	28.0%	32.0%	29.4%	5.8%	3.3%	8.0%
LA LIBERTAD	COVID Cases	170	643	1,204	1,220	1,394	1,155
	COVID Deaths	37	208	713	302	184	110
	CFR	21.8%	32.3%	59.2%	24.8%	13.2%	9.5%
AREQUIPA	COVID Cases	107	346	948	1,859	3,447	1,532
	COVID Deaths	9	36	150	366	302	146
	CFR	8.4%	10.4%	15.8%	19.7%	8.8%	9.5%
MOQUEGUA	COVID Cases	18	99	60	437	1,047	600
	COVID Deaths	1	5	19	65	79	26
	CFR	5.6%	5.1%	31.7%	14.9%	7.5%	4.3%
CUSCO	COVID Cases	8	86	71	496	1,679	742
	COVID Deaths	2	3	20	45	156	73
	CFR	25.0%	3.5%	28.2%	9.1%	9.3%	9.8%
LIMA	COVID Cases	4,767	11,922	10,278	10,500	15,665	9,271
	COVID Deaths	965	2,247	2,114	1,751	1,777	1,262
	CFR	20.2%	18.8%	20.6%	16.7%	11.3%	13.6%

Sources: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe) -

<https://cloud.minsa.gob.pe/s/Y8w3wHsEdYQSZRp/>

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Calculations: J Chamie. [JuanJChamie@gmail.com](mailto:JuanJChamie@gmail.com)

## Deaths and Population

Data from national deaths

		Apr	May	Jun	Jul	Aug	Sep
LORETO	Deaths	319	819	293	157	171	126
	Expected deaths	96	96	96	96	96	96
	Excess Deaths	224	724	198	62	76	31
	Excess deaths/pop	0.27%	0.86%	0.23%	0.07%	0.09%	0.04%
UCAYALI	Deaths	238	550	162	138	113	73
	Expected deaths	88	88	88	88	88	88
	Excess Deaths	151	463	75	51	26	-15
	Excess deaths/pop	0.29%	0.90%	0.14%	0.10%	0.05%	-0.03%
PIURA	Deaths	486	1,727	1,159	740	789	627
	Expected deaths	353	353	353	353	353	353
	Excess Deaths	133	1,374	806	387	436	274
	Excess deaths/pop	0.06%	0.59%	0.34%	0.17%	0.19%	0.12%
TUMBES	Deaths	90	200	247	110	87	68
	Expected deaths	49	49	49	49	49	49
	Excess Deaths	41	151	198	61	38	19
	Excess deaths/pop	0.15%	0.54%	0.70%	0.22%	0.13%	0.07%
LA LIBERTAD	Deaths	416	702	1,754	1,640	946	617
	Expected deaths	462	462	462	462	462	462
	Excess Deaths	-46	241	1,293	1,179	485	156
	Excess deaths/pop	-0.02%	0.09%	0.50%	0.46%	0.19%	0.06%
AREQUIPA	Deaths	441	504	914	2,112	1,477	627
	Expected deaths	384	384	384	384	384	384
	Excess Deaths	57	120	530	1,728	1,093	243
	Excess deaths/pop	0.03%	0.06%	0.25%	0.81%	0.52%	0.11%
MOQUEGUA	Deaths	31	41	69	249	360	80
	Expected deaths	51	51	51	51	51	51
	Excess Deaths	-20	-10	18	198	309	29
	Excess deaths/pop	-0.07%	-0.03%	0.06%	0.68%	1.06%	0.10%
CUSCO	Deaths	309	317	341	554	1,063	503
	Expected deaths	339	339	339	339	339	339
	Excess Deaths	-30	-22	3	216	725	165
	Excess deaths/pop	-0.02%	-0.02%	0.00%	0.16%	0.52%	0.12%
LIMA	Deaths	4,384	8,897	9,205	8,558	8,413	5,225
	Expected deaths	2,204	2,204	2,204	2,204	2,204	2,204
	Excess Deaths	2,180	6,693	7,001	6,354	6,209	3,021
	Excess deaths/pop	0.13%	0.41%	0.42%	0.39%	0.38%	0.18%

Sources: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe) -

<https://cloud.minsa.gob.pe/s/NctBnHXdnocgWAg>

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## Total weekly deaths

	LORETO	UCAYALI	PIURA	TUMBES	LA LIBER TAD	AREQUI PA	MOQUE GUA	CUSCO	LIMA
Week 15	21	25	77	18	93	100	4	75	763
Week 16	33	24	93	23	84	103	5	64	1,010
Week 17	111	75	129	29	111	100	11	77	1,193
Week 18	211	147	213	17	118	106	12	74	1,498
Week 19	265	174	315	30	120	101	7	80	1,645
Week 20	216	144	402	42	126	110	9	60	1,972
Week 21	143	115	446	45	167	116	10	75	2,128
Week 22	119	64	438	66	214	124	11	68	2,387
Week 23	80	36	364	76	292	144	17	73	2,339
Week 24	85	41	292	60	398	176	13	79	2,270
Week 25	60	44	274	46	462	237	8	87	2,148
Week 26	55	33	200	49	458	247	23	77	1,915
Week 27	47	29	200	43	415	347	23	74	1,897
Week 28	43	30	150	22	437	442	27	95	1,904
Week 29	34	36	185	27	389	484	42	111	1,946
Week 30	27	25	173	29	341	508	85	133	1,932
Week 31	35	33	149	21	284	527	96	213	2,003
Week 32	55	23	184	24	230	412	125	228	2,060
Week 33	28	31	171	24	234	369	93	244	2,012
Week 34	36	31	188	12	196	334	63	277	1,835
Week 35	37	22	170	17	198	233	52	227	1,784
Week 36	33	13	162	21	158	203	31	160	1,522
Week 37	30	20	154	13	149	157	19	141	1,340
Week 38	32	19	159	17	150	145	18	101	1,207
Week 39	27	16	126	12	132	122	16	96	1,040
Week 40	24	19	123	17	123	114	15	91	980
Week 41	29	28	120	12	116	113	14	85	958
Week 42	32	19	106	22	107	110	13	74	827

Sources: Datos Abiertos Gobierno de Perú - [datosabiertos.gob.pe](https://datosabiertos.gob.pe) -

<https://cloud.minsa.gob.pe/s/NctBnHXDnocgWAg>

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## Excess Deaths (from March to September 2020)

	Deaths	Expected death..	Excess deaths	Excess deaths/..	Population 60+
LORETO	2,016	650	1,367	1.62%	84,137
UCAYALI	1,367	604	764	1.48%	51,639
PIURA	5,793	2,483	3,310	1.41%	234,250
TUMBES	874	350	524	1.86%	28,166
LA LIBERTAD	6,540	3,262	3,279	1.27%	257,655
AREQUIPA	6,495	2,688	3,807	1.79%	212,228
MOQUEGUA	874	361	513	1.76%	29,157
CUSCO	3,410	2,489	921	0.66%	138,969
LIMA	47,596	14,352	33,244	2.02%	1,648,028

Sources: Datos Abiertos Gobierno de Perú - <https://cloud.minsa.gob.pe/s/NctBnHXDnoccgWAg>

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